

IOWA STATE UNIVERSITY

Digital Repository

Retrospective Theses and Dissertations

Iowa State University Capstones, Theses and
Dissertations

1988

A study about LDCs' debt problem

Mashaalah Rahnema-Moghadam
Iowa State University

Follow this and additional works at: <https://lib.dr.iastate.edu/rtd>



Part of the [Economics Commons](#)

Recommended Citation

Rahnema-Moghadam, Mashaalah, "A study about LDCs' debt problem " (1988). *Retrospective Theses and Dissertations*. 8798.
<https://lib.dr.iastate.edu/rtd/8798>

This Dissertation is brought to you for free and open access by the Iowa State University Capstones, Theses and Dissertations at Iowa State University Digital Repository. It has been accepted for inclusion in Retrospective Theses and Dissertations by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

UMI[®]

Order Number 8825949

A study about LDCs' debt problem

Rahnama-Moghadam, Mashaalah, Ph.D.

Iowa State University, 1988

U·M·I

**300 N. Zeeb Rd.
Ann Arbor, MI 48106**

A study about LDCs' debt problem

by

Mashaalah Rahnama-Moghadam

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major: Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1988

TABLE OF CONTENTS

	Page
DEDICATION	iii
CHAPTER I. INTRODUCTION	1
Exposures of the Large Banks to the Risk of Defaults by Less-Developed Countries	9
Purpose of the Dissertation	11
CHAPTER II. REVIEW OF THE LITERATURE	13
Literary Discussions	13
Kristin Halberg	13
Barend A. de Vries	15
Irving S. Friedman	17
Leonard J. Santam	22
William Darity, Jr.	25
Descriptive Statistics	28
Richard P. Mattione	28
Statistical Inference	31
William R. Cline	31
Theoretical Discussion	36
Jürg Niehans	36
CHAPTER III. MODEL SPECIFICATIONS	41
Objective of Study	42
General Description of the Statistical Technique Being Used in This Study	43
General Description of What I Want to Do in This Study	50
CHAPTER IV. DATA AND RESULTS	62
CHAPTER V. SUMMARY AND CONCLUSION	85
BIBLIOGRAPHY	87
ACKNOWLEDGMENTS	89

DEDICATION

I dedicate this humble work to my beautiful wife, Hedayeh Samavati.

CHAPTER I. INTRODUCTION

In August 1982, Mexico declared that it could not meet its debt-servicing obligations. After that announcement, Brazil and some other debtor countries followed Mexico, declaring that they also were unable to meet their debt obligations.

Since then, world financial institutions have realized that they are faced with one of the most difficult situations of their history. Countries which have received hundreds of billions of dollars as loans from western banks and financial institutions are declaring, one after another, that they cannot pay the interest and amortization of their debts. For example, according to World Bank data, in 1981 alone 13 countries asked for reschedulings of their debts (World Bank, 1985, p. 4). In 1983, 31 cases of reschedulings of debts involving 21 countries were recorded (World Bank, 1985, p. 110).¹ In 1984, another 31 cases of rescheduling of debts were recorded (World Bank, 1985).

In order to have a better understanding of the problem, we will review a short history of the debt crisis of the less-developed countries.

Throughout history, capital has flowed from richer to poorer countries. This is because capital is relatively scarce in poorer countries and the rate of return on capital is higher. In richer

¹During a fiscal year, a debtor country can reschedule its debt several times, depending upon the situation. Arrangements concluded with creditors in the same year are regarded as separate reschedulings. That is why the number of reschedulings are greater than the number of debtor countries.

countries, which are in higher states of development, capital is relatively abundant; therefore, the rate of return on capital is lower.

Foreign capital helps less-developed countries overcome their economic and financial problems. It has helped a lot of countries when they have faced financial difficulties, such as might occur because of a large decrease in the price of their exports. As a result of such a situation, they need funds to meet their external obligations and their internal economic plans and developments. Foreign capital has helped less-developed countries to make substantial economic and social progress. There is much evidence that capital flows to these countries have helped them to increase the standard of living and life expectancy of their people. At the same time, infant mortality has been halved and primary school enrollment rates have risen from 50 to 94 percent (World Bank, 1985) during the last two decades, i.e., 1960-82. The growth rate of GNP and GDP of less-developed countries averaged six percent per year from 1960-1980 (World Bank, 1985, p. 3).

Considering the past years, we see that debt-servicing difficulties have been something normal and common but never as severe as in recent years. In the 19th century, several countries faced debt-servicing problems because of their domestic economic policies and external economic crises. For example, in the 1870s, the Turks and Peruvians had difficulties fulfilling their external debt obligations. In the 1880s and 1890s, the Argentineans and Brazilians had the same difficulties.

The structure of financial flows to developing countries has changed several times through history. Before World War I, the main source of

capital was private bond markets. In the 1930s, following the Great Depression, there were several defaults by borrowing countries, both industrial and developing countries. Because of that, commercial bank lending to developing countries stopped. After World War II, capital flows to less-developed countries occurred mainly through the official sector. The largest part was bilateral (governments and governmental agencies), but some was channeled through new institutions like the World Bank and the International Development Association. These channels, along with private direct investment and the supplying of credits, were the main source of credits and finance for less-developed countries until the late 1960s.¹ After the 1960s, commercial banks started to play a prominent role in lending money to less-developed countries.

We should notice that when creditors lend money to these less-developed countries, they are ready to assume some risks related to these loans because less-developed countries may be faced with some internal and external economic and political difficulties. Therefore, what is new is the speed and severity of the crisis.

Most scholars and experts of the world financial system believe that the developing countries' current debt problems probably began after the oil price increase of 1973. Data show that at the end of 1972, the external debt of developing countries was almost evenly divided between

¹There are three main sources of funds from which less-developed countries can borrow: official sources which are composed of governments and governmental agencies (also called bilateral lenders), international organizations (called multilateral lenders), and private sources which consist of commercial banks and private investors who invest in less-developed countries.

official and private creditors. At the end of 1972, non-oil developing countries¹ owed 46 percent of their external debt to the official sector and 54 percent to the private sector (Claudon, 1986, p. 12). After the first oil price shock in 1973, non-oil developing countries needed more money to finance their current account deficits, so they tried to find new sources of funding to overcome their deficit problems. They turned to private creditors, which were mainly banks. As a result of that, the external debt of these developing countries to the private sector increased from 54 percent in 1972 to 62 percent in 1984 (Claudon, 1986). By the end of 1984, the commercial banks' share of the total publicly guaranteed medium and long-term debt² owed by nonoil developing countries amounted to 86 percent (Claudon, 1986, p. 12). So, overall it is clear that the banks' share of the debt owed by the less-developed countries has increased dramatically. Because of that, they became more involved with the economic and political situations in these countries. Commercial banks became more vulnerable to the risks of debt-servicing problems and defaults of less-developed countries. After the oil price shock, the number of defaults increased. In 1975, 15 countries had difficulty servicing their external debts, and by the end of 1981, more than 32 countries were experiencing the same difficulty (Claudon, 1986, p. 12). These countries were unable to fulfill their external debt

¹Oil exporting countries are defined by the IMF as those developing countries whose oil exports equal at least 100 million barrels per year. All other developing countries are called non-oil developing countries.

²Publicly guaranteed debts are external obligations of private debtors that are guaranteed for repayment by a public entity of the debtor country.

responsibilities. As Table 1.1 (Claudon, 1986, p. 24) shows, the external debt of non-oil developing countries has increased from 130.1 billion dollars in 1973 to 711 billion dollars in 1984.

Table 1.1. External debt of non-oil developing countries from 1973 to 1984 (in billions of dollars) (Claudon, 1986, p. 24)

1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
130.1	160.8	190.8	228.0	280.3	334.3	395.3	475.2	559.6	633.3	668.6	710.9

We see that in nominal terms, the debt of 142 non-oil developing countries increased approximately 5.5 times from 1973 to 1984. If we add to that number the debt owed by the five OPEC countries that are not in capital surplus (Algeria, Ecuador, Indonesia, Nigeria, and Venezuela), the total debt of developing countries reached 812 billion dollars in 1984.

The current situation is very fragile. By the end of 1985, the 16 largest less-developed countries have 520 billion dollars in external debts and interest payments. They have to pay 55 billion dollars annually for the principal and interest on their external loans. The three largest debtors of developing countries to the U.S. banks are Brazil, Mexico, and Argentina. These three countries alone owe U.S. banks something around 52.4 billion dollars.

We have to consider that because of the high volume of debt of borrowing countries and the large size of interest of these loans, western banks and other creditors reduced loans to these countries. This restriction imposed extreme financing constraints on the non-oil developing countries which needed new loans in order to meet their debt-servicing. Reduction of new loans to less-developed countries by financial institutions made many less-developed countries unable to meet their external debt obligations. So by the end of 1984, an increasing number of less-developed countries sought to reschedule their external debt payments. During 1983, about 30 countries completed or were trying to reschedule their debts. These 30 countries owed more than half of the external debt of all developing countries. Data show that for early 1985, the external debt of developing countries was 812 billion dollars and annual debt service payments were 122 billion dollars (Claudon, 1986, p. 14).

Much of the developing countries' debt is owed by a few countries. For example, Brazil, Argentina, Mexico, Korea, and Indonesia--the five largest debtor countries--owe more than 30 percent of the total debt of the developing countries (Claudon, 1986). It is interesting to see that the exposure¹ of banks to these countries increased very rapidly; it more than tripled from December 1978-December 1982. In 1982, U.S. banks' total lending to developing countries was about 37 percent of total bank lending to these countries.

¹Exposure of a bank means the ratio of the bank's loans to less-developed countries to its capital. This ratio is multiplied by 100 to be presented as a percentage.

If we look at Table 1.2 (Claudon, 1986, p. 41) we realize that, relative to capital, exposure of U.S. banks to East European and non-oil developing countries increased from 132 percent in 1977 to 155 percent in 1982. This ratio for the nine largest U.S. banks was 188.2 percent in 1977 and increased to 235.1 percent in 1982. Over 60 percent of lending to developing countries was done by these nine largest U.S. banks in 1982.

Table 1.2: Exposure of U.S. banks to non-oil developing countries and eastern Europe, relative to capital, 1977-82 (percent end of year)

	1977	1978	1979	1980	1981	1982
<u>All U.S. banks</u>						
Non-oil developing countries	114.9	114.4	124.2	132.3	148.3	146.1
Mexico	27.4	23.4	23.0	27.6	34.3	34.5
Brazil	29.4	28.6	27.3	25.4	26.9	28.9
Eastern Europe	16.7	15.8	16.1	13.9	12.9	8.9
<u>Nine largest U.S. banks</u>						
Non-oil developing countries	163.2	166.8	182.1	199.3	220.6	221.2
Mexico	32.9	30.4	29.6	37.8	44.4	44.4
Brazil	41.9	42.4	40.3	39.3	40.8	45.8
Eastern Europe	25.0	23.5	23.9	21.8	19.5	13.9

We also can consider some ratios like: ratio of debt to GNP, ratio of debt to exports, debt service ratio,¹ and ratio of interest service to

¹Debt service ratio is defined as the ratio of total debt services to exports of goods and services.

GNP of the developing countries. These ratios for selected years between 1970 and 1984 show the overall situation of the less-developed countries in terms of their debt. The data for these ratios are listed in Table 1.3 (World Bank, 1985, p. 24).¹

Table 1.3. Debt indicators for developing countries in selected years, 1970-1984 (percent end of year)

All developing countries	1970	1974	1976	1978	1980	1981	1982	1983	1984
Ratio of debt to GNP	14.1	15.4	18.1	21.0	20.9	22.4	26.3	31.3	33.8
Ratio of debt to exports	108.9	80.0	100.2	113.1	89.8	96.8	115.0	130.8	135.4
Debt service ratio ^a	14.7	11.8	13.6	18.4	16.0	17.6	20.5	19.0	19.7
Ratio of interest service to GNP ^b	.5	.8	.8	1.1	1.6	1.9	2.3	2.3	2.8

^aDebt service ratio is the ratio of total debt services to exports of goods and services.

^bRatio of interest service to GNP is the ratio of interest payments (excluding the repayments of principal on external debt) on external debt to GNP.

The above data show that all of the ratios have increased from 1970 to 1984. This trend indicates that, in general, less-developed countries

¹Interest and debt service for 1970-83 are actual (not contractual) service paid during the period.

are facing more difficulties meeting their debt-servicing and payments. For example, the ratio of debt to exports provides a rough estimate of the countries' financial difficulties. If this ratio is high, it means that a large portion of export earning goes toward the servicing of foreign debts. A rising ratio of debt to GNP also indicates that a rising portion of the nation's output is likely to be needed to service debt.

Exposures of the Large Banks to the Risk of Defaults by Less-Developed Countries

The relationship between commercial banks and developing countries has been transformed in the past 15 years. As mentioned earlier, before 1970, bank lending to developing countries was relatively small. After 1970, banks slowly became a major source of foreign funds for developing countries. Therefore, banks became more vulnerable to debt-servicing problems of the less-developed countries. Consider the following data in Table 1.4 which show the exposure of the 18 largest U.S. banks at the end of 1982 to five Latin American countries that had debt-servicing difficulties (Cline, 1984, p. 24).

Table 1.4 shows that the U.S. banking system as a whole and these 18 largest banks in particular are potentially very vulnerable to the debt crisis of the developing countries.

To see the situation better, consider Argentina, Mexico, and Brazil. If these three countries do not service their debts completely for one year, it will cause cash-flow declines equal to 47 percent of the capital

Table 1.4. Exposure as a percentage of capital, major banks, end-1982
(Cline, 1984, p. 24)

Bank	Argentina	Brazil	Mexico	Venezuela	Chile	Total	Capital ^a
Citibank	18.2	73.5	54.6	18.2	10.0	174.5	5989
Bank of America	10.2	47.9	52.1	41.7	6.3	158.2	4799
Chase Manhattan	21.3	56.9	40.0	24.0	11.8	154.0	4221
Morgan Guaranty	24.4	54.3	34.8	17.5	9.7	140.7	3107
Manufacturers Hanover	47.5	77.7	66.7	42.4	28.4	262.8	2592
Chemical	14.9	52.0	60.0	28.0	14.8	169.7	2499
Continental Illinois	17.8	22.9	32.4	21.6	12.8	107.5	2143
Bankers Trust	13.2	46.2	46.2	25.1	10.6	141.2	1895
First Nat'l Chicago	14.5	40.6	50.1	17.4	11.6	134.2	1725
Security Pacific	10.4	29.1	31.2	4.5	7.4	82.5	1684
Wells Fargo	8.3	40.7	51.0	20.4	6.2	126.6	1201
Crocker Nat'l	38.1	57.3	51.2	22.8	26.5	196.0	1151
First Interstate	6.9	43.9	63.0	18.5	3.7	136.0	1080
Marine Midland	n.a. ^b	47.8	28.3	29.2	n.a.	n.a.	1074
Mellon	n.a.	35.3	41.1	17.6	n.a.	n.a.	1024
Irving Trust	21.6	38.7	34.1	50.2	n.a.	n.a.	996
First Nat'l Boston	n.a.	23.1	28.1	n.a.	n.a.	n.a.	800
Interfirst Dallas	5.1	10.2	30.1	1.3	2.5	49.2	787

^aCapital in million dollars.

^bNot available.

of the nine U.S. largest banks. Data show that in 1983, for example, Argentina, Mexico, and Brazil owed 31.3 billion dollars to the nine largest banks whose capital is only 29 billion dollars. In addition, these three countries owed about 3.4 billion dollars in interest and 6.9 billion dollars in short-term debt payments as well as 3.4 billion dollars in long-term debt payments; so in 1983, these three countries together owed about 13.7 billion dollars of debt-service payments to the nine largest banks. In 1983, the capital of these banks totaled about 29.0 billion dollars, so a cash flow decline of 13.7 billion dollars would equal 47 percent of the combined capital for these nine largest banks (Cline, 1984, p. 27).

Purpose of the Dissertation

The description of the world debt situation shows that the issue is very urgent and serious. Economists and experts on the issue have conducted a lot of studies about it.

In Chapter II, I will review the most important literature on the world debt crisis. In the current literature about the LDCs' debt problems, authors assume (or at least they guess) that there are some relationships between the economic ratios (indicators such as the ratio of debt to GNP or the ratio of debt to exports, etc.) of the debtor countries and the rescheduling by them of debts. For example, they mention frequently that a particular debtor country has been forced to reschedule its debt servicing because its ratio of debt to exports was high (see Claudon, 1986, p. 48) and so on. Therefore, in this study I

try to clarify this point and find out whether or not in fact there are such relationships between the economic ratios of the debtor countries and the probability of default by them. I will take some of the most important (as well as those mentioned in the literature) economic ratios of the debtor countries (as long as available data permit) and use a probit probability model to study the subject. Therefore, the independent variables will be the economic ratios of the debtor countries and the dependent variable will be the probability of default by them.

In Chapter III, I will review the probit probability technique as well as my own study concerning the world debt crisis in detail.

In Chapter IV, I will discuss the data and I will report the econometric results of this study.

Chapter V summarizes the dissertation and offers some conclusions.

CHAPTER II. REVIEW OF THE LITERATURE

Since the outbreak of the international debt crisis, many papers and books have been published on the subject. Economists, experts in international finance, and employees of international financial institutions like the IMF and the World Bank have studied the international debt crisis very carefully. After studying and analyzing the problem, they have come up with some conclusions and solutions to the problem. These studies have been documented in different books and journals.

In this chapter, I will review some of the most important and relevant studies about the international debt problem.

Literary Discussions

Kristin Halberg

Kristin Halberg (Assistant Professor of Economics at Colby College and an expert in international trade and finance) believes that there are three causes of the debt problems of the less-developed countries. These causes are: external economic shocks, internal LDCs' (less-developed countries) economic policy, and western banks' loan policies. As external economic shocks Kristin Halberg considers industrial countries' monetary, fiscal, trade, and regulatory policies. Kristin Halberg argues that industrial countries responded to the first oil-price shock by choosing an expansionary monetary policy, which, together with the oil-price increase, caused a large increase in inflation rates (Halberg,

1986, p. 10). So average annual inflation rates increased from 4.7 percent during the years 1963-72 to above ten percent in 1974-75. Real interest rates (measured as Eurodollar rates minus the rate of increase in the U.S. producer price index) fell to an average -0.8 percent for 1971-80; real interest rates were negative on average for the decade (IMF, 1982). Since the cost of borrowing was very low, LDCs increased their borrowing from abroad to avoid rapid adjustment due to the external shocks which could damage their development plans. On the other hand, when the second oil-price shock happened, industrial countries responded to that by choosing different economic policies. Governments of the industrial countries adopted tight monetary policies in order to fight against inflation. This tight monetary policy, together with high inflationary expectations, raised real interest rates to almost ten percent in 1981. High real interest rates put a lot of pressure on LDCs to meet their debt obligations. Therefore, Kristin Halberg blames the industrial countries' monetary policies, especially the U.S. monetary policy, as an external cause of the LDCs' debt servicing problems. (Halberg, 1986, p. 11).

Halberg also considers the trade policies of the industrial countries as another external cause of the current LDCs' debt problems. High unemployment rates in the industrial countries in the early 1980s led to protectionist pressures (quantitative restrictions and voluntary export restrictions on LDCs' exports) that made it more difficult for LDCs to export to markets of the industrial countries (Halberg, 1986, p. 11). Halberg mentions internal domestic demand pressures in the LDCs

as internal LDCs' economic policies (economic policies which are designed to satisfy the domestic demand), which contributed to their payments problems. In non-oil LDCs, according to Halberg, excess domestic demand in the 1970s and early 1980s is usually attributed to expansionary government expenditure that led to fiscal deficits and overvalued real exchange rates. These fiscal deficits caused high inflation rates in most non-oil LDCs. Therefore, fiscal deficits, domestic demand pressures, inflation, and overvalued real exchange rates all together caused the deterioration of the current-account balances of the LDCs (Halberg, 1986, p. 11).

Also, LDCs should be blamed because they used borrowed money for consumption, financing private capital outflows, and acquisition of foreign assets rather than domestic investment. Halberg believes that western banks' loan policies have also contributed to the debt problems of the LDCs. Banks reduced their loans to LDCs perceiving that those countries cannot adjust to the deterioration in the world economy. Also, banks became more cautious about the risks involving loans to LDCs. Banks, instead of increasing risk premium on loans to LDCs, reduced the amount of new loans to LDCs. Reduction in banks lending to LDCs, coincident with the increase in interest rates and declining export earnings, caused a big increase in the number of countries experiencing debt servicing difficulties.

Barend A. de Vries

Barend A. de Vries (past Senior Adviser and Chief Economist at the World Bank) examines the debt problems of the LDCs and comes to the

conclusion that the behavior of the international commercial banks and their smaller regional and local agencies is the key. They play a critical, if not dominant, role in any future loans because these banks lend money to LDCs without considering how well the money has been used to benefit the economies of the LDCs. These kinds of policies are wrong and banks should correct their loan policies. In the past, banks did not apply internal measures to assure that their loans were well used. They did not apply any measure to stop the loans which could not benefit the LDCs' economies (de Vries, 1986, p. 64). There are some loans to the LDCs that have been used for the wrong purposes, such as financing capital flight or unrecorded imports of military equipment. Also, before lending money to these developing countries, banks should study the economic policies of the borrower countries, country-by-country. de Vries argues that usually countries that suffer debt servicing problems adopt economic policies which lead to an appreciation in the real exchange rate, a high debt-exports ratio, high inflation, excessive public sector deficits, overextended state enterprises, and price controls or subsidization or both. These economic policies most of the time discourage the coordination of external credits and the channeling of capital to investments with high economic yields (de Vries, 1986, p. 65).

de Vries believes that there should be some internal structural adjustments in LDCs in order to make them able to meet external shocks. These internal structural adjustments include:

- a. keeping the exchange rate abreast of inflation,
- b. liberalizing import regulations in line with the objectives of greater industrial efficiency,
- c. helping export industries by further removing the biases against them in the incentive system and strengthening their ability to invest and modernize,
- d. improving public sector management through the economic evaluation of key investments, programming, macroeconomic modeling and improving the data base, completing public sector projects with high economic returns, for example, in the steel and electric power industries, and
- e. rationalizing domestic credit markets and strengthening the private industrial sector.

If the LDCs can make the above internal adjustments then they will be able to resist external shocks and improve their debt service difficulties (de Vries, 1986, p. 68).

Irving S. Friedman

Irving S. Friedman (an expert in international finance with experience in the IMF, World Bank, Citibank, and First Boston Corporation) believes that some LDCs need a net inflow of resources over a long period of time. They need this net inflow of funds even to maintain existing standards of living, given the large rate of growth in their population and the urbanization of all these LDCs. It is not a sign of economic weakness for a country to be in external debt in order to

finance its development plans from capital inflows as well as domestic savings. LDCs can even finance their investments with funds borrowed on commercial terms. If the country is well-managed economically and remains creditworthy, it can continue to borrow and ease the burden of repayments (Friedman, 1983, p. 77). But, structural changes in the international economy, including the repeated increases in the price of oil, global inflation and a long period of low rate of growth of economies in the developed countries have an adverse impact on LDCs because both the volume and price of commodity exports from the third world have decreased and that has created acute problems for many LDCs. The governments of these LDCs should adjust their development patterns and economic structures to the substantial changes in the international economic environment. One of the economic policies that borrowing countries should follow is the policy that makes them able to export goods and services to creditor countries, either directly or indirectly, in order to obtain the surpluses in foreign exchange needed to pay amortization and interest. Also, there is always the possibility that the externally borrowed funds are financing consumption rather than strengthening the productive capacity of the borrowing country (Friedman, 1983, p. 85). This policy of increasing consumption through borrowing can reduce domestic savings, decrease exports, increase imports, reduce investment in domestic production and as a result of that the balance of payments deficit will increase.

When western banks make loans to LDCs, they have to realize that there is a risk involved. Friedman believes that the risk in inter-

national lending by private banks or by any private investors cannot be eliminated. But, risk can be managed in such a way that it can increase the power of the private banks that do international lending. Lending overseas is a potential source of strength for the banks and not a source of weakness. The important point is the anticipation of changes. The key is being able to react quickly to changes in the borrower countries and avoid excessive losses caused by failure to anticipate the changes. Banks should anticipate the changes in the borrower LDCs and react in such a manner as to protect the bank from eventual loss, even in the case of disruption of debt servicing causing temporary losses (Friedman, 1983, p. 209). So far, among the major banks there has not been any standard system for evaluating risks and changes in the borrower LDCs. In most banks, country evaluation was undertaken at headquarters by the bank's line personnel without critical reviews by another group in the institution. Some banks use quantitative techniques in order to evaluate the risk of lending to a particular country. Then they use the results of that evaluation with some qualitative techniques to come to the conclusion. Some banks use either a letter or numerical rating to summarize the results from the country evaluation system in setting maximum exposure limits (Friedman, 1983).

Friedman believes that as far as the calculation of the risk of lending to LDCs is concerned, in general there exist three basic country evaluation systems. These three systems are commonly used by commercial banks and may be categorized as follows.

The first system of evaluation of the risk of lending to LDCs is the Delphi/expert opinion (Friedman, 1983, p. 212). The Delphi/expert opinion approach consists of a panel of experts who rate each country's performance based on a set of elements assumed to be influencing that country's future. Responses to those elements are weighed, aggregated, and compared. Next, a panel of experts comes to some conclusion about the risk of lending to that country. However, the information obtained using the Delphi method is too generalized to be significantly useful in making specific business decisions (Friedman, 1983). The Delphi/expert opinion approach has four specific drawbacks.

- a. It is difficult for private banks to give confidential business information to panels and relate business decision-making to panels.
- b. It is difficult to transform this into an approved method of continuous assessment of changing situations, so that this method is not well-designed for anticipating risk.
- c. It is difficult and costly to set up the panel of experts with the rich experience and knowledge which is required for high-level professional opinion on the countries.
- d. It obscures responsibilities for country evaluations.

The second method is quantitative/econometric, which focuses and transfers risk, or on the potential of a country having balance of payments difficulty. In this method, the first step is to identify countries with the potential balance of payments difficulties. They consider some of the economic variables that they think are very

important. Then they highlight and select those important economic variables and develop econometric models. According to these econometric models, they predict the balance of payments behaviors of these LDCs. Also, to assess a country's likely response to balance of payments difficulties, the results of the initial econometric models are often reviewed with qualitative data before judgments become final. The econometric approach has its limitations in reliability and usefulness, even if expanded to include noneconomic factors, for the following reasons.

- a. For many countries, the needed reliable data for such methods are not available.
- b. Even if available, relevant historical experience is limited or can be misleading as a basis for anticipating the future.
- c. The predictive quality of such models has repeatedly proven weak.
- d. Facts used in country evaluations are restricted too narrowly in order to fit methodology. For example, they do not include qualitative aspects which do not lend themselves to quantification.
- e. The method underestimates the importance of policy responses to balance of payments difficulties (Friedman, 1983, p. 212).

The third method of risk-evaluation of lending to LDCs is integrated and comprehensive in scope. This method has three distinct components.

- a. The likelihood of balance of payments difficulties (as with the quantitative/econometric approach).

b. Likely country responses to possible balance of payments difficulties.

c. Outlook for risks other than payments and likely country responses where appropriate.

Among the three country-risk evaluation systems mentioned above, the integrated and comprehensive approach is the most reliable one (Friedman, 1983, p. 215). Because it includes all different quantitative and qualitative data and information, it considers the accumulated knowledge of bank officers and their experiences. This method also identifies banks' business interests and possible related country risks. This method aims to be comprehensive enough to cover all important and significant identifiable risk factors. It is integrated enough to reach the conclusions. This approach can be adjusted with the rest of the bank's activities (Friedman, 1983, p. 216). The notion of risk is a broad notion, so we have to choose a methodology which is broad and complicated. A bank must include all potential significant risks when it is doing country assessments and does not confine itself to those which have appeared in the past or in other countries or for other banks. It is important to anticipate the way changes in country conditions will occur and not just react to the current events.

Leonard J. Santam

Leonard J. Santam, one of the experts in international finance and debt problems of the LDCs, studied the debt situation of the LDCs. He came to the following conclusion.

Santam says that the U.S. and other major industrial countries should agree to remove their domestic imbalance between monetary and fiscal policies. One of the steps that these industrial countries should take is to pledge a maximum budget deficit as a percentage of their GNP (Santam, 1986, p. 99). This maximum budget deficit should be something like three or four percent of the GNP. At the same time, the monetary authorities of these countries should bring down the interest rates to the levels that will stimulate their economies. He says that the U.S. budget deficit is the key place to start because the U.S. is the biggest lender of funds to LDCs and U.S. banks are more involved in lending money to LDCs than any other industrial countries' banks. He says that the U.S. government should decrease its deficit by two means. The U.S. government should increase its receipts and reduce the growth in its spending. He argues that "a national sales tax on the receipts side used as a surcharge when the deficit exceeds certain targets and a ceiling on expenditures rather than a ceiling on debt is the best combination to start with" (Santam, 1986, p. 101). He believes that these actions will decrease the strength of the dollar, limit the size of debtor countries' interest payments, and allow debtor nations to keep their interest rates lower. These policies will help to stimulate the economies of the U.S. and the major debtor countries. LDCs will be able to increase their exports and meet their international interest and principal payments more easily. Also, commercial banks which have lent to these LDCs can get a steadier stream of payments and the risk of lending money to these countries can decrease. Santam again argues that industrial countries

and their central banks should follow such domestic economic policies that reduce the possibility of recessions. He argues that the key factor should be reducing economic adversity and economic variability, because what really hurts the debtor countries is economic fluctuations in the industrial countries. When the debtor countries want to control inflation and have a steady growth in their exports, they need stable outside economies. It is very difficult for these debtor countries to accomplish their economic plans when their economies fluctuate in a substantial way due to outside forces that are beyond their control. The point is that if there is a predictable stable economy in the industrial countries, that will reduce the outside shocks for the LDCs which are under debt. Therefore, they get the chance to work on their domestic economic problems and try to find a solution for the domestic problems.

Considering the roles of the IMF and the World Bank as the two principal lenders to LDCs, he argues that the IMF, instead of telling debtor countries what kind of economic goals they must achieve, should base its assistance on whether the debtor countries have paid their debts on time or not. Most of the time, he says, the economic goals that the IMF suggests to the LDCs do not have political and social practicality. Santam says that the World Bank should increase its role as an investor in LDCs or as a lender to LDCs, because the World Bank has more flexibility than the IMF in terms of financial capabilities and access to funds.

Santam reviews the financial institutions of the U.S. (as the biggest industrial country) and the roles that these institutions can

play to solve the debt problems of the LDCs. He comes to the conclusion that the Federal Reserve should allow commercial banks to borrow under the "extended credit" category at a rate below the market rate in order to make additional funds available to major debtor countries, but only if the banks set up larger loan-loss reserves (Santam, 1986, p. 103). He continues that when new loans are given to LDCs by the commercial banks, the debtor countries should have the option of making their payments with dollars, marks, or yen. At the same time, central banks should set up a pool of funds that will compensate the commercial banks' losses in case of the foreign exchange losses because of these kinds of loans. Commercial banks should not make new loans to these LDCs which just allow them to pay the interest on the old loans, because such an approach allows major debtor countries to borrow additional funds often without attacking their basic problems (Santam, 1986, p. 106). At the end, Santam suggests that the governments of the industrial countries should take more active roles in lending to LDCs. The justification for this view is that a high number of bank problems and failures because of the loans to LDCs lead to a lot of economic difficulties in the industrial countries, and the problem is so large that only the governments of these industrial countries can solve the problem. Also, many of the major debtor countries are political and military allies of the industrial countries.

William Darity, Jr.

In another study, William Darity, Jr., develops the notion of "pushing" loans on the LDCs by commercial banks. Darity says that

pushing loans does not mean that bankers force LDC officials to accept loans. Pushing loans involves very soft terms relative to the expectations of the borrowers. Commercial banks, in an effort to dispose of their surplus funds, reduce the difference between their cost of funds (LIBOR, London Inter Bank Offer Rate) and the loan rate that they offer LDC borrowers. Also, they increase the amount of the loan and length of the maturity of the loan. Commercial banks give loans to LDCs with very favorable terms only when loan demand from sources in the developed world is not enough to be profitable for them. Darity considers four hypotheses which are related to the loan-push phenomenon. These four hypotheses are the following:

- a. The rational expectations hypothesis. This hypothesis is explained and justified as follows:

LDCs are becoming the major global industrial sites. Deindustrialization in the developed countries and industrialization in the LDCs has shifted the marginal product of capital. The rate of return on capital in the LDCs has risen relative to the developed countries. The structural change in the world economy, which has shifted industrial growth toward some of these LDCs, is the fundamental cause of the increase in debt (Darity, 1986, p. 205).

Another argument in the context of the rational expectation approach is that the debt crisis is the outcome of a random shock such as a sudden increase in oil price. The oil price

shock sent the borrowing nations into difficulty on their debt payments.

The other argument in this framework is that bankers made the loans expecting the majority of them to go bad, or at least being indifferent to whether or not the loans went bad. This is because there is the possibility that a loan that is bad from the standpoint of repayment and use of it need not be bad from the standpoint of bank profitability. The other reason is that the larger banks have a reasonable pecuniary incentive for setting up the foreign loan syndication. These banks usually get loan fees for establishing a consortium of lenders and they receive this money at first regardless of the fate of the loan. Also, U.S. bankers were urged to lend to the LDCs in the early 1970s by the U.S. Treasury and Federal Reserve officials for political reasons. Bankers legitimately could believe there was a governmental obligation to bail them out in a time of crisis.

- b. Institutional weaknesses. This hypothesis says that bad loans were made because bankers did not have enough information or they did not investigate the circumstances of the borrowers adequately.
- c. Overborrowing. This says that borrowers simply borrowed an unreasonable amount of loans. This can be due to lack of good sense about policymaking to achieve growth via borrowing on the part of LDC finance ministers (Darity, 1986, p. 216), or it can be due to the judgments and decisions by national leaders to

LDCs, for their personal political objectives and not for economic objectives like economic growth and development.

- d. Financial instability hypotheses. This says that when there are economic booms in the industrial countries, banks will make more loans to LDCs. LDCs will use these loans to repay their existing debts and achieve some economic targets. But when there are economic downturns in the industrial countries, banks are not able to make more loans to the borrowing LDCs. LDCs that have been depending on these loans for running their economies (repay the interest and principal of existing debts, achieving economic growth and development) are not able to meet their debt obligations, so they default. In this case, debt crisis and economic cycles are interrelated.

Descriptive Statistics

Richard P. Mattione

Richard P. Mattione (Economist and Research Associate at the Brookings Institution's Foreign Policy Studies Program) also identifies three causes of the debt problems of LDCs as external economic shocks, internal LDCs' domestic economic policy, and western banks' loan policies. But, he disputes the relative importance of each of the above three causes. For example, as an external economic shock he considers the oil-price shocks which caused a deterioration in the terms of trade

of the oil-importing LDCs and caused current account deficits for them (Mattione, 1986, p. 45).

When there are external economic shocks,¹ LDCs choose economic policies to adjust their economies to those external shocks. Mattione examines Table 2.1 in this regard (Claudon, 1986, p. 46).

Table 2.1. Adjustment efforts in selected developing countries, 1972-82 (\$ billion)

Country	External shock	Current account change ^a	Capital flight ^b
Argentina	-13.4	-18.9	-14.3
Brazil	-48.5	-23.6	2.0
Chile	-4.8	-8.5	1.0
Colombia	-6.8	-6.6	0.7
Mexico	11.7	-18.7	-15.2
Nigeria	32.7	1.0	0.4
Peru	0.4	1.3	1.3
Philippines	-8.1	-4.4	-1.4
Venezuela	19.1	19.5	-13.0

^aAdjusted for inflation.

^bA minus sign denotes capital flight; that is, an unfavorable movement in the relevant items of the capital account.

¹Four categories of shocks are calculated for each country. These shocks are: terms-of-trade shock, variations in Western demand on nonoil exports, high real interest rates shock, and current account shock. Calculations in this study are based on methods developed by Balassa, 1981.

From Table 2.1 we see that Brazil was the country experiencing the biggest dollar shock. But, Brazil actively adjusted itself to the external shock in the sense that the current account position deteriorated by less than the amount of the unfavorable external shocks. The same story is true with respect to the Philippines. Colombia was essentially neutral. On the other hand, domestic economic policies in Chile and Argentina increased the effects of the unfavorable shocks. Also, in Mexico in spite of favorable external shocks, poor internal economic policies caused a large deterioration of its current account. Poor domestic policies also contributed to capital flight in these countries. This was because the real exchange rate appreciated sharply from 1978 to 1982 in most of the LDCs. LDCs faced large-scale capital flights because of the expectation that higher returns could be earned abroad (Claudon, 1986, p. 46).

Mattione also argues that one of the reasons that LDCs are forced into rescheduling their debt is because the debt/export ratios in these countries are high. The debt/export ratio is high because there is a gap between the short-term loans (these loans are usually eight-year loans that banks prefer to lend to LDCs) and the 15 to 30 years necessary for LDCs to be able to repay (Claudon, 1986, p. 48). In order to fill this gap between short-term loans and the long term necessary for the payments, LDCs try to borrow more. Therefore, they always have a large debt/export ratio; increasing exports in the short run is difficult. Mattione argues that the cure of the debt problems of LDCs is that they should adopt such domestic policies that contribute to the expansion of

their exports. In order to have a successful domestic economic policy to achieve the above goal (increasing exports), LDCs should examine the global economic environment and the options available to them. In the end, Mattione concludes that a sustained recovery in industrial countries, if it is supported by continuing adjustment policies in debtor nations, can be enough to rescue these countries from their debt problems (Claudon, 1986, pp. 43-62).

Statistical Inference

William R. Cline

William R. Cline (author of several books on the world debt crisis), studying the debt problems of LDCs, says that in a broad sense the debt problem is a consequence of the transition from inflation to disinflation in the world economy. LDCs borrowed money when inflation was high and real interest rates were low or even negative. But, now when inflation is low and real interest rates are high, borrowed funds by LDCs are no longer cheap. Therefore, LDCs are not able to meet their debt servicing obligations because of the pressure of the new economic environment (Cline, 1984, p. 1). He continues by noting that during the 1970s, banks lending funds to LDCs increased sharply due to the following reasons:

- a. There was a large increase in the deposits of the oil exporting countries in the western banks and a decrease in the demands for bank loans in the industrial countries because of the recession in these countries.

- b. There was growing international competition among European, Japanese, and regional U.S. banks for loans to LDCs.

After the eruption of the debt-servicing problems of the LDCs, lending banks realized that they needed better discipline and organization for lending funds to LDCs (Cline, 1984, p. 113). Cline argues that lack of information and the information gap about the borrowing countries and other lending competitors have been the major contributing factors in debt crises of the last few years. For example, individual banks did not know how rapidly their competitors were expanding lending, especially short-term lending, to the LDCs. By the time that banks found out about it, the situation was out of control. Cline suggests that a better information system can at least make a modest contribution to the ways of solving the debt problems (Cline, 1984).

Cline also conducted a projection model for studying debt and the balance of payments of LDCs. The approach of this study was to conduct projections of balance of payments and debt for the 19 largest debtor countries (Brazil, Mexico, Argentina, South Korea, Venezuela, Philippines, Indonesia, Israel, Turkey, Yugoslavia, Chile, Egypt, Algeria, Portugal, Peru, Thailand, Romania, Hungary, and Ecuador) for the period 1983-86. The study was conducted at the level of the individual country. Cline believed if the study were to be conducted considering these 19 countries together as one group, then it would disguise the severity of debt difficulties that might arise in each individual country. The aim of the study is to calculate the external current account deficit, other balance of payments items, the external debt for

each country for each year through 1986 under different assumptions about the economic conditions of the world. These different assumptions are specified in four areas: the rate of economic growth in industrial countries, the international interest rate (LIBOR, London Inter Bank Offer Rate), the price of oil, and the real exchange rate of the dollar relative to other major currencies. The projection model assumes the internal actions of the LDCs, such as their growth rates and their exchange rate policies, are given (Cline, 1984, pp. 40-67 and Appendix B).

The results of the basic simulations show three important conclusions. First, growth in the world economy will decrease the severity of the debt problem. Second, the debt problem is responsive to the growth in the world economy. For example, if the global economic growth rate is 2-1/2 percent or below, the situation remains little improved or deteriorates. Third, there is a powerful tendency for the debt situation to improve for the oil-importing countries. To a considerable degree, this sharply favorable trend for oil-importing countries is the consequence of substantial increases projected for their exports.

Cline offers Figure 2.1 for oil exporters as well as oil importers from his project model study (Cline, 1984, p. 48). Considering Figure 2.1 we should know that oil exports are more vital to the oil exporters than oil imports to the oil importers, because oil exports are 78 percent of the total exports of the oil exporting countries, on the average. Oil imports are 31 percent of total imports of the oil importer countries, on the average. Also, this study shows that with a given

Current account
deficit in
billion dollars

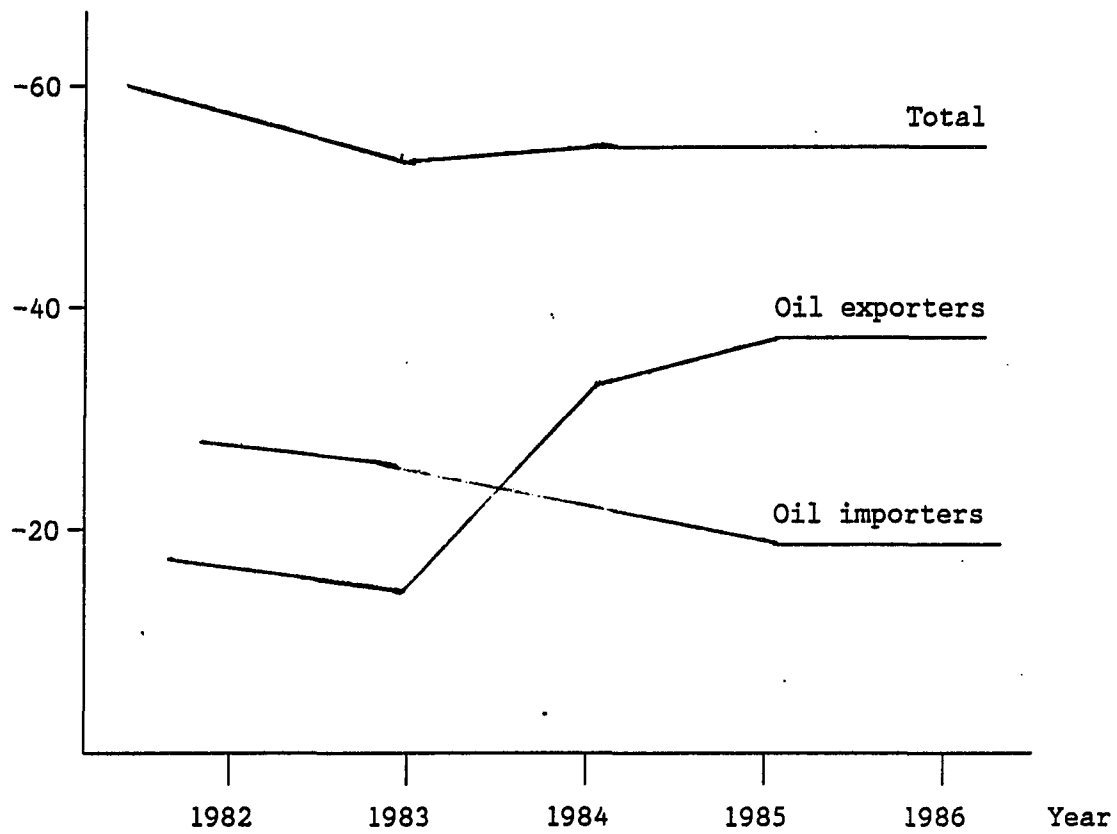


Figure 2.1. Projected current account deficits, 19 major debtor countries

three percent rate of growth in the global economy, countries like Brazil, Mexico, Argentina, Korea, Philippines, Turkey, Yugoslavia, Chile, Portugal, Thailand, Romania, and Hungary will have an improvement in their external debt situation by 1986. These countries had a total debt of \$361 billion in 1982. Also, the study shows that countries like Venezuela, Indonesia, Israel, Egypt, Algeria, Peru, and Ecuador will have a deterioration in their debt by 1986. In 1982, these countries had a total of \$123 billion as a debt.

A more precise evaluation of the debt problem of the LDCs is possible through the application of a statistical model of debt rescheduling. Cline uses logit statistical analysis explaining the occurrence of debt reschedulings in the period 1967-82 for 60 countries (Cline, 1984, Appendix A). This logit statistical analysis shows that debt rescheduling is associated with a high debt-service ratio, low ratio of reserves to imports, low rate of amortization, high current account deficit, low domestic growth rates, and a low level of international lending in relative terms (Cline, 1984, p. 67). Finally, he concludes that a critical threshold for industrial country growth in 1984-86 is three percent annually. If this growth rate can be achieved, the debt problems of the LDCs should be manageable and should show considerable improvement (Cline, 1984).

Theoretical Discussion

Jürg Niehans

Jürg Niehans (Professor at the University of Bern and Visiting Scholar at the Federal Reserve Bank of San Francisco) has developed a model studying the strategies of debtors as well as creditors. He says, "practical men of affairs, bankers, financial writers, and policymakers, can often be heard to say that a large part of the bank loans to governments of LDCs will never, in the aggregate, be repaid." Considering the above fact, he mentions that there is a fundamental difference between private domestic loans and international loans. In private domestic loans, you have the debt enforcement laws. If a debtor defaults on his obligations, he forfeits collateral. That is, his assets can be attached, impounded, or turned over to his creditors by a bankruptcy court. The debtor is put under strong pressure to live up to his obligations. The situation is different for bank loans to LDCs. In this case, there is usually no collateral and, at least in practice, no access to bankruptcy courts. This makes such loans legally unenforceable. Niehans, in his paper, analyzes the LDCs' debt with the assumption that there is no law enforcement to make LDCs repay their loans. Throughout his paper, he assumes that international lending, while important for the levels of output and consumption at any moment, has only a negligible influence on the rate of economic growth over decades. Niehans presents his model as follows.

Consider a country in balanced growth at a rate of g with net foreign debt A . Debt expands at the rate of

$$\alpha = \frac{dA}{dt} \cdot \frac{1}{A}.$$

Suppose the world interest rate is i . Now the net cash flow to the debtor country depends on the difference between new debt (dA/dt) and the interest payments on the existing debt (iA). Therefore, the cash flow formula is:

$$C = \frac{dA}{dt} - iA = A\left(\frac{dA}{dt} \cdot \frac{1}{A} - i\right) = (\alpha - i)A.$$

Depending upon the amounts of α and i , C can be positive or negative. That means that debtor countries can have trade deficits or surpluses (Niehans, 1985). The relationship between α and i depends on the relationship between α and g . If the rate of debt expansion (α) is different from the rate of economic growth (g), that implies that debt either increases beyond any limit relative to national income or else shrinks away. Within the framework of balanced growth, we assume $\alpha = g$. In balanced growth we have $g = i$ and as a result of that, the cash flow (C) in the above equation goes to zero at all times and so does the trade balance; interest payments are continuously reinvested.

When $g < i$, the cash flow is negative and the debtor needs a trade surplus to finance the excess of interest payments over new lending. If $g > i$, the debtor enjoys a positive cash flow forever, which finances a

permanent trade deficit and the present value of the cash flow is infinite.

However, the world is not in balanced growth. This raises the question: Under what conditions can a debt crisis generally be avoided despite the unenforceability of claims (Niehans, 1985, p. 70)?

The assumption is that the rate of interest is given by the market, but the available amounts of loans may be limited because banks may refuse to make loans to LDCs considering the risk of defaults by LDCs.

Niehans argues that if a debtor country with unenforceable debts is able to keep a positive cash flow at all times, then its aggregate borrowing is not subject to the usual efficiency criteria according to which the marginal return on investment must be no lower than the rate of interest (in the case of enforceable debt). If loans, in effect, turn into gifts, they cannot be excessive from the borrower's point of view (Niehans, 1985). With unenforceable contracts, debtors have an unlimited demand for loans. Therefore, the debtor country tries to maximize the present value of the cash flows from time zero to infinity. The borrowing country wants to maximize:

$$\int_0^{\infty} \left[\frac{dA}{dt} - iA(t) \right] e^{-it} dt.$$

In pursuing this objective, the borrower is constrained not by the cost of future debt service, but by the willingness of creditors to lend. If the interest rate is assumed to be given by the world market, this

constraint expresses itself in a quantitative limitation of the loan supply (Niehans, 1985).

Default will occur at time T if

$$\int_T^{\theta} \left[\frac{dA}{dt} - iA(t) \right] e^{-i(t-T)} dt < 0$$

for all θ from T to infinity. Niehans then believes that a rational debtor country will use the threat of repudiation to convince its creditors to negotiate a rescheduling of debt, lowering of interest rates, and extension of new loans.

Then, he considers the strategy of the creditors. He says that creditors have to plan aggregate lending in such a way that the present value of future cash flows to the debtor remains positive forever. This can be formalized as:

$$\int_T^{\infty} \left[\frac{dA}{dt} - iA(t) \right] e^{-i(t-T)} dt > 0$$

for all T . This is the solvency constraint. The larger the present value of the cash flow at any time, the larger is the safety margin against insolvency. The solvency constraint is necessary but is not sufficient for avoiding a debt crisis. In addition, each creditor must be confident that other creditors will continue to lend on an ever-increasing scale. In order to achieve that confidence, two things should happen. First, the rate of debt expansion eventually should approach the rate of growth. Second, creditors should consider the

optimal level of debt at a given time. But, with unenforceable claims, decentralized decision-making is likely to lead to crisis because continued debt service on each loan depends crucially on continued net lending by all lenders (Niehans, 1985, pp. 64-78).

CHAPTER III. MODEL SPECIFICATIONS

In Chapter II, I reviewed some of the literature about the world debt crisis. By studying the world debt crisis carefully, authors of the literature try to find out why it is that some debtor countries are forced to reschedule their debt payments and some are not. Among the causes of rescheduling of the debts by debtor countries, they have considered some economic indicators and ratios. For each debtor country, economic indicators like "ratio of external public debt to GNP," "ratio of current account balance to GNP," and so on, hypothetically can be considered as having something to do with the nature of the rescheduling of debts by debtor countries. For example, if "ratio of external public debt to GNP" is a high number for a debtor country, then it is highly possible that the country will not be able to meet its debt obligation and will be forced to reschedule its debt. William R. Cline has used several of these economic indicators and ratios in his study of the world debt crisis. As I discussed in Chapter II, Cline develops a statistical logit model to estimate the probability of the rescheduling of debts by debtor countries. Cline considers such economic ratios as: debt-service ratio,¹ ratio of reserves to imports, country's domestic rate of economic growth, real per capita income, current account deficit to exports of goods and services, net debt relative to exports, inflationary erosion of debt, amortization rate, the savings rate, and the growth of exports of

¹The debt-service ratio is defined as the ratio of total debt services to exports of goods and services.

each country under consideration. Then, Cline uses the above ratios as independent variables and regresses those ratios against the dependent variable, which takes on a value of one when the debtor country has rescheduled its debt payments and zero when it has not. Cline concludes that the level of real per capita income, saving rate, and inflationary erosion of debt are not statistically significant. William R. Cline is the only person who uses a logit statistical technique studying the problem of debt reschedulings by debtor countries. He wants to see the relationships between these selected economic indicators and the probability of debt rescheduling by debtor countries. The results of Cline's study are discussed in Chapter II.

Objective of Study

In this study, my objective is to develop a dichotomous qualitative model to study the following questions:

- a) Is there a relationship between the probability of debt reschedulings by LDCs and LDCs' economic indicators such as the ratio of current account balances to GNP, ratio of external public debt to GNP, etc.
- b) If there is a relationship between the probability of debt reschedulings by LDCs and some LDCs' economic indicators, then is this relationship positive or negative?
- c) Are there any relationships between the probability of debt reschedulings by LDCs and some forecasted economic ratios of LDCs?

I develop my model as follows. There are two groups of LDCs:

- 1) LDCs which have rescheduled their debts, because they have not been able to meet their debt obligations.
- 2) LDCs which have not rescheduled their debts. These LDCs have continued to meet their debt obligations.

The objective is to extend the tools of linear regression to develop a model in which the dependent variable is not continuous. Especially, I want to construct a model such that the dependent variable is associated with two values, one and zero.

General Description of the Statistical Technique Being Used in This Study

Consider the following regression for country i in year t :

$$R_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{3i} + \dots + b_m X_{mi} + \epsilon_i \quad (3.1)$$

where R_i is the dependent variable, which can adopt one of the two values, one or zero, as:

$$R_i = \begin{cases} 1 & \text{when country } i \text{ has rescheduled its debt payments.} \\ 0 & \text{when country } i \text{ has not rescheduled its debt payments.} \end{cases}$$

$b_0, b_1, b_2, b_3, \dots, b_m$ are coefficients to be estimated. $X_{1i}, X_{2i}, X_{3i}, \dots, X_{mi}$ are some economic ratios of country i . For example, X_{1i} can be the ratio of current account balance to GNP for country i , or X_{2i} can be

ratio of external public debt to GNP of country i , and so on. ϵ_i is the random residual.

It is reasonable to expect relationships between X_{1i} , X_{2i} , ..., X_{mi} , and R_i . The aim is to predict the likelihood that an individual country i with given X_{1i} , X_{2i} , ..., X_{mi} will default or not. Therefore, in this qualitative choice model, we are trying to determine the probability that an individual country i with a given set of attributes like X_{1i} , X_{2i} , ..., X_{mi} will make one choice (rescheduling its debt) or the alternative (continue to meet its debt obligations). We assume that the probability of a country making a given choice is a linear function of the country's attributes. Therefore, we have a linear probability model. We also make the following assumptions:

- a) ϵ_i is an independently distributed random variable with zero mean.
- b) As in the classical linear regression model, we are assuming that X_{1i} , X_{2i} , ..., X_{mi} are fixed.

Thus, the above regression equation can be interpreted as describing the probability that an individual country i will default or not, given the information about the X_{1i} , X_{2i} , ..., X_{mi} . X_{1i} , X_{2i} , ..., X_{mi} are economic ratios and indicators of country i .

Coefficients b_0 , b_1 , b_2 , ..., b_m measure the effect on the probability of default of a unit change in the X_{1i} , X_{2i} , ..., X_{mi} , respectively.

The interpretation of equation (3.1) as a linear probability model comes about when we take the expected value of each dependent variable

observation R_i :

$$E(R_i) = b_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + \dots + b_mX_{mi}.$$

Since R_i can take on only two values, one and zero, we can describe the probability distribution of R_i by letting:

$$\text{Prob}(R_i = 1) = P_i$$

and

$$\text{Prob}(R_i = 0) = 1 - P_i.$$

So,

$$E(R_i) = P_i(1) + (1 - P_i)0 = P_i.$$

Therefore, we can write:

$$E(R_i) = b_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + \dots + b_mX_{mi} = P_i.$$

We use the ordinary least squares estimation technique for unbiased estimations of parameters. Using the ordinary least squares technique for estimation results in heteroscedasticity in the linear probability model. It means that the variance of the error term is not constant for all observations. The presence of heteroscedasticity results in a loss of efficiency (we say that \hat{b} is an efficient unbiased estimator of b , if for a given sample size the variance of \hat{b} is smaller than the variance of

any other unbiased estimator) but it does not in itself result in either biased or inconsistent parameter estimates (Ladd, 1966).

There is one major problem with the linear probability model. When we try to use the linear probability model for prediction, the serious weakness of the model becomes apparent. Since the linear probability model involves the interpretation of predicted values of R_i as probabilities, we are faced with a problem when the predicted value lies outside the $(0, 1)$ range. One way to correct this problem is to set extreme predictions equal to one or zero to constrain predicted probabilities to be within the $(0, 1)$ interval. But, this solution of the problem is not satisfactory because it says that we may predict an occurrence with a probability of one when it is entirely possible that it may not occur. Or, we may predict an occurrence with probability zero when it may actually occur. Therefore, while the estimation procedure might yield unbiased estimates, the predictions obtained from the estimation process are biased. The better way to solve the problem is as follows:

We want to transform the original model in such a way that predictions will be in the $(0, 1)$ interval for all X s. Since our primary concern is to interpret the dependent variable in the model as the probability of making a choice (given information about the individual country's attributes), it is reasonable to use some notion of probability as the basis of the transformation. The requirement of such a process is that it translates the values of the attributes $X_{1i}, X_{2i}, \dots, X_{mi}$ which may range in value over the entire real line to a probability which

ranges in value from zero to one. Also, we want the transformation to maintain the property that increases (or decreases) in the X s are associated with increases (or decreases) in the dependent variable for all values of X s (Pindyck and Rubinfeld, 1981, p. 280). Therefore, we use a cumulative probability function.¹ The resulting probability distribution may be represented as:

$$P_i = F(b_0 + b_1 X_{1i} + b_2 X_{2i} + \dots + b_m X_{mi}) \quad (3.2)$$

where F is the cumulative probability function and the X s are stochastic.

While there are a lot of different cumulative probability functions, we shall consider the probit probability model, which is associated with the cumulative normal probability function. To understand this model, assume that there exists a theoretical (but not actually measured) index, Z_i , for each country i .

Z_i is determined by the explanatory variables X_{1i} , X_{2i} , ..., X_{mi} , as in the linear probability model. The index, Z_i , is assumed to be a continuous variable that is random and normally distributed for the usual econometric reasons. Therefore, we have:

$$Z_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + \dots + b_m X_{mi}. \quad (3.3)$$

¹The cumulative probability function is defined as having as its value the probability that an observed value of a variable X (for every X) will be less than or equal to a particular X . The range of the cumulative probability function is the $(0, 1)$ interval, since all probabilities lie between zero and one.

Substituting Z_i into equation (3.2), we get:

$$P_i = F(Z_i).$$

What makes this problem different from the standard problem in econometrics is that we assume that observations on Z_i are not available. Instead, we have data which distinguish only whether individual observations are in the one category (high values of the index Z_i) or a second category (low values of Z_i).

The problem that probit analysis solves is the problem of how to obtain estimates for the parameters $b_0, b_1, b_2, \dots, b_m$ while at the same time obtaining information about the underlying unmeasured scale index Z_i . To understand the technique, we consider the following example.

The individual country i is assumed to reschedule its debt or not when it is faced with the choice of one of the two. In this case, the index Z_i would represent the strength of the decision of country i for rescheduling of its debt. The index Z_i varies by country but more importantly it is an index that is not observable from available data. All we know is whether country i rescheduled its debt or not. Now suppose that we also know that the index of the strength of the debtor country's decision Z_i is a linear function of $X_{1i}, X_{2i}, \dots, X_{mi}$. Then, the probit model provides a suitable means of estimating the parameters of the relationships between the index Z_i and $X_{1i}, X_{2i}, \dots, X_{mi}$.

Now, the question is how does the index Z_i relate to the actual available information about the debt rescheduling of country i ? To

answer this question, assume that for each country i , Z_i^* represents the critical cut-off value which translates the underlying index, Z_i , into a decision-making. So, country i decides to reschedule its debt if $Z_i > Z_i^*$ or decides not to reschedule its debt if $Z_i \leq Z_i^*$.

The probit model assumes that Z_i^* is a normally distributed random variable so that the probability that Z_i^* is less than or equal to Z_i can be computed from the cumulative normal probability function. The cumulative normal function assigns to a number Z_i the probability that any arbitrary Z_i^* will be less than or equal to Z_i .

The standardized cumulative normal function is

$$\underline{P}_i = F(Z_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_i} e^{-1/2 s^2} ds.$$

Where S is a random variable which is normally distributed with zero mean and unit variance. By construction, \underline{P}_i will lie in the $(0, 1)$ interval. \underline{P}_i represents the probability of country i 's decision to reschedule its debt (Pindyck and Rubinfeld, 1981, Chapter 10).

When we use the probit model with individual observations, the most suitable estimation technique is that of maximum likelihood. In the maximum likelihood estimation, all parameter estimators are consistent and also efficient. All parameter estimators are known to be normal so that the regression t -test can be applied. If we wish to test the significance of all or a subset of the coefficients in the probit model when maximum likelihood is used, a test using the chi-square distribution replaces the usual F test.

General Description of What I Want
to Do in This Study

1) I will use a probit model to estimate the probability of default by each debtor country. For that I will divide LDCs into two groups as:

- a) LDCs that have rescheduled their debt payments, and
- b) LDCs that have not rescheduled their debt payments, i.e., they have continued to fulfill their debt obligations.

Then, I will calculate the following seven economic ratios and indicators:

- 1) the ratio of gross domestic investment to GNP,
- 2) the ratio of gross national savings to GNP,
- 3) the ratio of current account balance to GNP,
- 4) the ratio of gross international reserves to imports,
- 5) the ratio of interest payments on external public debt to exports,
- 6) the ratio of external public debt to GNP, and
- 7) the ratio of debt service to GNP.

For each country i , I will take the above seven economic ratios and indicators as independent variables. The dependent variable will be assigned one when country i has rescheduled its debt payments and zero when country i continues to meet its debt obligations. I will have a linear probability model for each country i in year t as:

$$Y_{it} = a_0 + a_1X_{1it} + a_2X_{2it} + a_3X_{3it} + a_4X_{4it} + a_5X_{5it} \\ + a_6X_{6it} + a_7X_{7it} + \epsilon_{it}$$

where i denotes the country i and it takes on values 1, 2, 3, ..., 44-- i.e., I will run the above linear probability model across 44 countries in year t .

Then, by the method of transformation that I described before, I will transform the above linear probability model into a probit probability model. Therefore, by that transformation, I will be able to estimate the probability of default by country i in year t given country i 's set of attributes $X_1, X_2, X_3, \dots, X_7$.

X_{1it} = The ratio of gross domestic investment to GNP for country i in year t .

X_{2it} = The ratio of gross national savings to GNP for country i in year t .

X_{3it} = The ratio of current account balance to GNP for country i in year t .

X_{4it} = The ratio of gross international reserves to imports for country i in year t .

X_{5it} = The ratio of interest payments on external public debt to exports for country i in year t .

X_{6it} = The ratio of external public debt to GNP for country i in year t .

X_{7it} = The ratio of debt service to GNP for country i in year t .

Y_{it} = The dependent variable for country i in year t where:

$$Y_{it} = \begin{cases} 1 & \text{when country } i \text{ has rescheduled its debt payments in year } t \\ 0 & \text{when country } i \text{ has not rescheduled its debt payments in the year } t, \text{ i.e., it has continued to meet its debt obligations.} \end{cases}$$

The above model will be estimated by using ordinary least squares for the linear probability model and the maximum likelihood technique for the probit probability model. e_i is an independently distributed random variable with zero mean.

I will run the above regression model for 44 countries and for the years 1983 and 1984. These 44 countries and their positions with respect to rescheduling of their debt in different years are shown in Table 3.1. I will analyze the relationships between the above econometric ratios of country i and the probability of default by country i in each year. Then, I will compare the results of years 1983 and 1984 to each other. I will also compare my results to William R. Cline's results. There are two economic ratios, the ratio of reserves to imports and the ratio of gross national savings to GNP, which I use in my study and Cline uses in his study.

2) In the second part of this section of my study, again I apply a linear probability model for the same countries, but this time I use seven different economic ratios as independent variables. Therefore, the linear probability model for country i in year t will be:

$$Y_{it} = b_0 + b_1W_{1it} + b_2W_{2it} + b_3W_{3it} + b_4W_{4it} + b_5W_{5it} \\ + b_6W_{6it} + b_7W_{7it} + a_{it}$$

where i stands for country i and takes on values 1, 2, 3, ..., 44.

Again, I will transform the above linear probability model into the probit probability model, so I will be able to estimate the probability

Table 3.1. Debt rescheduling among the 44 LDCs which are considered in this study for the years 1983 and 1984

Names of the countries	Rescheduling position				
	1980	1981	1982	1983	1984
Algeria	0	0	0	0 ^a	0
Argentina	0	0	0	1 ^b	1
Bolivia	0	1	0	1	1
Brazil	0	0	0	1	1
Cameroon	0	0	0	0	0
Chile	0	0	0	1	0
Colombia	0	0	0	0	0
Costa Rica	0	0	0	1	0
Ecuador	0	0	0	1	1
Egypt	0	0	0	0	0
Ethiopia	0	0	0	0	0
Ghana	0	0	0	0	0
Guatemala	0	0	0	0	0
India	0	0	0	0	0
Indonesia	0	0	0	0	0
Ivory Coast	0	0	0	0	1
Jamaica	0	1	0	1	1
Kenya	0	0	0	0	0
Korea (South)	0	0	0	0	0
Liberia	1	1	1	1	1
Malawi	0	0	1	1	0
Malaysia	0	0	0	0	0
Mexico	0	0	1	1	1
Morocco	0	0	0	1	1
Niger	0	0	0	1	1
Nigeria	0	0	0	1	0
Pakistan	0	1	0	0	0
Papua New Guinea	0	0	0	0	0
Peru	0	0	0	1	1
Philippines	0	0	0	0	1
Portugal	0	0	0	0	0
Senegal	0	1	1	1	1
Sierra Leone	1	0	0	0	1
Sri Lanka	0	0	0	0	0
Sudan	0	1	1	1	1
Tanzania	0	0	0	0	0
Thailand	0	0	0	0	0
Tunisia	0	0	0	0	0

^a0 means the country has not rescheduled its debt, i.e., it has continued to meet its debt services.

^b1 means the country has rescheduled its debt.

Table 3.1. Continued

Names of the countries	Rescheduling position				
	1980	1981	1982	1983	1984
Turkey	0	1	0	0	0
Uruguay	0	0	0	1	0
Venezuela	0	0	0	0	1
Yugoslavia	0	0	0	1	1
Zaire	1	1	0	1	0
Zambia	0	0	0	1	1

of default by country i in year t given country i 's set of attributes,

W_1, W_2, \dots, W_7 . The economic ratios are:

W_{1it} = Ratio of international reserves to imports of goods and services for country i for year t .

W_{2it} = Ratio of debt outstanding and disbursed¹ to exports of goods and services for country i for year t .

W_{3it} = Ratio of debt outstanding and disbursed to GNP (Gross National Product) for country i for year t .

W_{4it} = Ratio of total debt services to exports of goods and services (debt-service ratio) for country i for year t .

W_{5it} = Ratio of total debt services to GNP for country i for year t .

W_{6it} = Ratio of interest payments to exports of goods and services (interest-service ratio) for country i for year t .

¹Debt outstanding and disbursed represents the amount of public and publicly guaranteed loans that have been disbursed, net of repayments of principal and write-offs at year end.

W_{7it} = Ratio of international reserves to debt outstanding and disbursed for country i for year t .

Y_{it} = The dependent variable for country i in year t where:

$$Y_{it} = \begin{cases} 1 & \text{if country } i \text{ has rescheduled its debt payments in year } t \\ 0 & \text{if country } i \text{ has not rescheduled its debt payments in year } t \text{ and it has continued to meet its debt obligations.} \end{cases}$$

a_{it} = Independently distributed random variable with zero mean.

This model will be estimated using ordinary least squares estimation techniques for the linear probability model and maximum likelihood estimation techniques for the probit probability model. I will run the above regression model for the same 44 countries and for the year 1984.

I will analyze the relationships between the above economic ratios of country i and the probability of default by country i in the year 1984. Also, in the end of this section I will pool the data for the years 1980, 1981, 1982, 1983, and 1984 and run the above regression for the data of these years combined. (In the next chapter I will describe the procedure of pooling the data.) And, I do compare the results of these different studies.

There are a few economic ratios, such as the ratio of gross international reserves to imports of goods and services, the ratio of debt outstanding and disbursed to GNP, the ratio of total debt services to GNP, and the ratio of interest payments on external public debt to exports of goods and services, which are common in both previous parts, i.e., (in part 1) and in this part (part 2). The reason for using the

same economic ratios in both studies (both parts 1 and 2) is that the data sources are different. In part 1 I use the data from various issues of World Development Reports (World Bank, various issues), and I calculate several of these economic ratios (I will list them in the next chapter) using those data, whereas in part 2 I use the data from various issues of World Debt Tables (World Bank, various issues). Although both of these publications are by the World Bank, in some cases the numbers are different. Therefore, in order to dismiss any confusion and uncertainty, I have decided to use both of these data sets (economic ratios) in my study in two independent parts (parts 1 and 2). The ratio of total debt services to exports of goods and services (debt-service ratio) is different from the ratio of interest payments on external public debt to exports of goods and services. This is so because by definition (this definition is given by the World Bank, 1985, p. 236), the total debt service is the sum of the interest payments on external public debt and repayments of principal on external public debt.

We expect the following signs for the coefficients of the variables (economic ratios) under consideration:

The sign of the coefficient of the ratio of international reserves to imports of goods and services should be negative. Because when reserves are high it is likely that, when the country imports more than exports, it can meet the obligation through drawdowns of its reserves. Therefore, the higher is the ratio of international reserves to imports, the lower is going to be the probability of demand for rescheduling the debt by debtor country i .

The ratio of total debt services to exports of goods and services (debt-service ratio) should have a coefficient with positive sign. This ratio is an indicator for creditworthiness. The higher the ratio of debt services to exports of goods and services, the greater will be the likelihood that in the event of a severe decline in export earnings the country will no longer be able to meet debt-service obligations.

The above story is true when we consider the ratio of interest payments on external public debt to exports of goods and services (interest-service ratio). Since debt service is the sum of the interest payments on external debt and repayments of principal on external debt, the debt-service ratio and interest service ratio have the same nature. So we expect that the sign of the coefficient of interest-service ratio be positive too. It means the higher the ratio of interest payments on external public debt to exports of goods and services (interest-service ratio) is, the higher will be the probability of debt rescheduling by the debtor country i.

Sign of the coefficient of the ratio of debt outstanding and disbursed to exports of goods and services should be positive. The higher is the ratio of debt outstanding and disbursed to exports of goods and services the higher will be the likelihood that the earning from exports of goods and services is not enough to service the debt and, hence, rescheduling of debt service may be requested. We conclude that a higher debt to exports ratio means a higher probability of debt rescheduling by debtor country i.

The coefficient of the ratio of debt outstanding and disbursed to GNP should be positive meaning the higher the ratio of debt outstanding and disbursed to GNP is, the higher the probability of debt rescheduling by country i will be. The coefficient of the ratio of total debt services to GNP should be position; it can be interpreted that a higher ratio of total debt services to GNP increases the likelihood of debt rescheduling by debtor country i .

The sign for the coefficient of international reserves to debt outstanding and disbursed should be negative, since higher international reserves relative to debt enables the debtor country to meet its debt obligations in the time of severe economic situation.

The ratio of gross national savings to GNP should have a negatively signed coefficient, because when saving is a higher portion of GNP, then the potential of the country to repay its debt is higher. Then, the higher gross national savings to GNP decreases the probability of debt rescheduling by debtor country i .

If investment is taking place in country i and if investment is efficient and productive, it can increase income of the country. Therefore, the country with higher income is more likely to be able to face economic difficulties. Therefore, in a country in which investment is a greater portion of its GNP, the possibility of meeting debt obligations is higher. Using the above facts, I expect a negative sign for the coefficient of ratio of gross domestic investment to GNP. This means if a debtor country i has a higher ratio of gross domestic investment to GNP, the likelihood that country i reschedules its debt is lower.

The sign of the coefficient of the last variable (ratio of current account balance to GNP) under consideration is positive. If a debtor country i has a deficit in its current account balance, and if the country i is short of international reserves, the probability of debt rescheduling by country i should be close to one. Therefore, the sign of the coefficient should be positive.

3) In the last part of my study, I apply a linear probability model for the same countries, but this time I will use seven forecasted economic ratios (the same seven economic ratios that I used in the second part) as independent variables. Therefore, the linear probability model for country i in year t (where year t is 1985) will be:

$$Y_{it} = C_0 + C_1\hat{W}_{1it} + C_2\hat{W}_{2it} + C_3\hat{W}_{3it} + C_4\hat{W}_{4it} + C_5\hat{W}_{5it} + C_6\hat{W}_{6it} + C_7\hat{W}_{7it} + a_{it}$$

where i stands for country i and takes on values 1, 2, 3, ..., 44. Also, I will transform the above linear probability model into the probit probability model, so I will be able to estimate the probability of default by country i in year t given country i 's set of attributes $\hat{W}_1, \hat{W}_2, \hat{W}_3, \dots, \hat{W}_7$.

\hat{W}_{1it} = Forecasted value of the ratio of international reserves to imports of goods and services for country i for year t .

\hat{W}_{2it} = Forecasted value of the ratio of debt outstanding and disbursed to exports of goods and services for country i for year t .

\hat{W}_{3it} = Forecasted value of the ratio of debt outstanding and disbursed to GNP (Gross National Product) for country i for year t .

\hat{W}_{4it} = Forecasted value of the ratio of total debt services to exports of goods and services (forecasted value of debt-service ratio) for country i for year t .

\hat{W}_{5it} = Forecasted value of the ratio of total debt services to GNP for country i for year t .

\hat{W}_{6it} = Forecasted value of the ratio of interest payments to exports of goods and services for country i for year t .

\hat{W}_{7it} = Forecasted value of the ratio of international reserves to debt outstanding and disbursed for country i for year t .

I run the above regression for forecasted economic ratios for 1985. Then, I will study and analyze the results. I will use regression forecasting techniques to forecast the independent variables \hat{W}_1 , \hat{W}_2 , \hat{W}_3 , ..., \hat{W}_7 for each country i for the year 1985. Since I have only 11 years of annual data, the forecasting method is per force naive; I simply extrapolate from a linear time trend. Comparing the first set of economic ratios (in part 1) and the second set of economic ratios (in part 2) I have to mention the following:

I have only two years of observations for the economic ratios in part 1, i.e., I have two years of data for 1983 and 1984. These data are not enough for forecasting, whereas I can provide data (data for the economic ratios, and not data for the rescheduling position) for the years 1970, 1974, 1975, 1976, 1978, 1979, 1980, 1981, 1982, 1983, and

1984, if I consider the economic ratios in part 2. In this case, I can use these ratios (economic ratios in part 2) to get the forecasted economic ratios for 1985. Therefore, this is the reason why I use the second economic ratios for part 3 of my study.

CHAPTER IV. DATA AND RESULTS

1) In this section, for each debtor country i I consider the following regression:

$$P_t = \alpha_0 + \alpha_1 X_{1t} + \alpha_2 X_{2t} + \alpha_3 X_{3t} + \alpha_4 X_{4t} + \alpha_5 X_{5t} + \alpha_6 X_{6t} + \alpha_7 X_{7t} + \epsilon_t \quad (4.1)$$

where t stands for the year under consideration and P is the probability of rescheduling of the debt by debtor country i and, of course $0 \leq P \leq 1$. $\alpha_0, \alpha_1, \dots, \alpha_7$ are coefficients. $X_1, X_2, X_3, \dots, X_7$ are economic ratios (indicators) of debtor country i and are defined as:

X_1 = ratio of gross domestic investment to GNP,

X_2 = ratio of national savings to GNP,

X_3 = ratio of current account balance to GNP,

X_4 = ratio of gross international reserves to imports,

X_5 = ratio of interest payments on external public debt to exports,

X_6 = ratio of external public debt to GNP, and

X_7 = ratio of debt services to GNP.

The data are obtained from various issues of World Development Reports published by the World Bank. (The first three ratios are taken from various issues of World Development Reports and the last five ratios are calculated by using the data from various issues of World Development Reports.)

First, I consider the data for 1983. Therefore, equation (4.1) is estimated as a probit probability model for 1983. The six alternative models shown in Table 4.1 represent alternative combinations of economic ratios (variables) when some variables are excluded. If we consider model A, we see that only variables X_5 (ratio of interest payments on external public debt to exports), X_6 (ratio of public debt to GNP), and X_7 (ratio of debt services to GNP) are highly significant. We can interpret them as follows: the ratio of interest payments on external public debt to exports is highly significant (it has high "t" statistic,¹ i.e., it is significant at five percent) and carries the expected positive sign, meaning a higher ratio of interest payments on external public debt to exports causes a higher probability of rescheduling. The same thing is true with respect to variable X_6 . This means the ratio of external public debt to GNP is highly significant (it has a high t-statistic, i.e., it is significant at one percent) and has the expected positive sign. This can be interpreted as a higher ratio of external public debt to GNP causes a higher probability of rescheduling. Now, if we look at variable X_7 (ratio of debt services to GNP), it is significant (it has a high t-statistic, i.e., it is significant at five percent) but surprisingly it has an unexpected negative sign. This means higher ratio of debt services to GNP causes a lower probability of rescheduling. χ^2

¹A t-statistic of equal or greater than |2.57| indicates that the coefficient is significantly different from zero at the one percent level of significance. A t-statistic of equal or greater than |1.96| indicates that the coefficient is significantly different from zero at the five percent level of significance. Also, a t-statistic of equal or greater than |1.64| indicates that the coefficient is significantly different from zero at the ten percent level of significance.

Table 4.1. Estimation of the probit model of debt reschedulings

Model	A	B	C	D	E	F
X ₁	2.0343 (.76263) ^b	1.9404 (.047435)	- ^a	-	-	-
X ₂	-1.9826 (-.74396)	-1.9762 (-.048308)	-	-	-	-.04124 (1.0830)
X ₃	2.0303 (.76246)	1.9177 (.046878)	-	-	.072155 (1.3179)	-
X ₄	.72719 (.96928)	.34972 (.62602)	-	.22726 (.34430)	-	-
X ₅	13.971 (2.0225)	-	10.214 (2.1295)	9.6625 (1.9234)	8.8416 (1.7582)	11.313 (2.1965)
X ₆	.086998 (3.0671)	-	.048192 (3.2067)	.049597 (3.1476)	.066251 (3.0243)	.062765 (2.9707)
X ₇	-.47364 (-2.4646)	-	-.27601 (-2.1671)	-.27694 (-2.1666)	-.29417 (-2.1793)	-.35982 (-2.3674)
Observations	44	44	44	44	44	44
Reschedulings	20	20	20	20	20	20
Chi-squared	29.3505	5.899	20.2952	20.4127	22.2238	21.5326
Degrees of freedom	7	4	3	4	4	4

^a- means not included.

^bT-statistics are in parentheses.

(chi-squared) is significant at .5 percent. This suggests variation in the probability of rescheduling is very well explained by these considered economic ratios in the multiple regression equation (equation 4.1).

In models C, D, and F, again we see that variables X_5 , X_6 , and X_7 are significant. Also, χ^2 is significant at the .5 percent level for those models. The interpretations of the results of models C, D, and F are exactly the same as the interpretation of model A in all aspects.

In model E, when we have a combination of variables X_3 , X_5 , X_6 , and X_7 , we see that only variables X_6 and X_7 are significant. This means the ratio of external public debt to GNP (X_6) is significant at one percent and has the expected positive sign. Therefore, we can conclude that a higher ratio of external public debt to GNP causes a higher probability of rescheduling. Also, variable X_7 (ratio of debt services to GNP) is significant at five percent and has the unexpected negative sign, meaning a higher ratio of debt services to GNP causes a lower probability of rescheduling. Again, this is surprisingly against the expected sign. χ^2 for model E is significant at .5 percent meaning the variation in probability of rescheduling is very well explained by considered economic variables X_3 , X_5 , X_6 , and X_7 in model E. In model B, none of the economic ratios is significant, also χ^2 is not significant.

In general, we can conclude that there are three economic ratios, namely X_5 (ratio of interest payments on external public debt to exports), X_6 (ratio of external public debt to GNP), and X_7 (ratio of debt services to GNP), which are significant in models A, C, D and F.

Economic ratio X_6 is significant in model E, and economic ratio X_7 , although it is significant in model E, has the unexpected negative sign.

The probability of rescheduling the debt by debtor country i can be explained by looking at economic ratios X_5 , X_6 , and X_7 . In other words, the probability of rescheduling of the debt by country i is influenced by these economic ratios: X_5 , X_6 , and X_7 . X_7 (ratio of debt services to GNP), although it influences the probability of rescheduling the debt by country i , has the unexpected negative sign.

Apparently, variables X_1 (ratio of gross domestic investment to GNP), X_2 (ratio of gross national savings to GNP), X_3 (ratio of current account balance to GNP), and X_4 (ratio of gross international reserves to imports) are not influential factors in rescheduling the debt by debtor country i .

In this part of section 1, again I use the same seven economic ratios (variables), X_1 , X_2 , X_3 , ..., X_7 . But, this time I consider the data for the year 1984. Therefore, equation (4.1) is estimated as a probit probability model for 1984. Data are obtained from various issues of World Development Reports published by the World Bank and again some of the ratios are calculated from the data.

The six alternative models shown in Table 4.2 represent alternative combinations of economic ratios (variables) when some variables (economic ratios) are excluded.

In model A, three variables, X_5 (ratio of interest payments on external public debt to exports), X_6 (ratio of external public debt to GNP), and X_7 (ratio of debt services to GNP), are significant. X_5 (ratio of interest payments on external public debt to exports) is significant

Table 4.2. Estimation of the probit model of debt rescheduling

Model	A	B	C	D	E	F
X ₁	.51801 (1.1072) ^b	.50210 (.028496)	-	- ^a	-	-
X ₂	-.46389 (-1.0045)	-.52290 (-.29676)	-	-	-	-.008419 (.29642)
X ₃	.45251 (.98209)	.48495 (.027522)	-	-	.003586 (.096481)	-
X ₄	.54256 (.73850)	.37646 (.64246)	-	.11961 (.18757)	-	-
X ₅	8.4460 (2.1610)	-	5.7186 (1.8723)	5.4556 (1.6268)	5.6849 (1.8483)	5.8200 (1.8896)
X ₆	.03500 (2.6911)	-	.027491 (2.6788)	.027977 (2.6391)	.027899 (2.5060)	.029247 (2.4604)
X ₇	-.36484 (-2.6284)	-	-.19451 (-1.9619)	-.19564 (-1.9722)	-.19578 (-1.9489)	-.20644 (-1.9237)
Observations	44	44	44	44	44	44
Reschedulings	18	18	18	18	18	18
Chi-squared	15.9445	3.71564	11.1633	11.1986	11.1726	11.2509
Degrees of freedom	7	4	3	4	4	4

^a- means not included.

^bT-statistics are in parentheses.

at five percent and carries the expected positive sign. It can be interpreted as: a higher ratio of interest payments on external public debt to exports causes a higher probability of rescheduling of the debt by debtor country i .

Variable X_6 (ratio of external public debt to GNP) is significant at one percent and has the expected positive sign. It means a higher ratio of external public debt to GNP causes a higher probability of rescheduling. Now, again, if we look at variable X_7 (ratio of debt services to GNP) it is significant at one percent, but the coefficient has the negative sign which is unexpected. That means a higher ratio of debt services to GNP causes a lower probability of debt rescheduling by the debtor country i . For model A, χ^2 (chi-squared) is significant at the five percent level of significance. This gives the information that variation in the probability of rescheduling of debt by debtor country i is very well explained by considering the economic ratios X_1 , X_2 , X_3 , ..., X_7 in model A. In model B, none of the variables, X_1 , X_2 , X_3 , and X_4 , are significant meaning they do not affect the probability of the rescheduling of debt by the debtor country i . Also, χ^2 for model B is not significant. So, variation in the probability of rescheduling is not explained by X_1 , X_2 , X_3 , and X_4 .

The interpretations of models C, D, E, and F are exactly like the interpretation of model A. In models C, D, E, and F again we see that variables X_5 , X_6 , and X_7 are significant at five, one, and five percent, respectively. Also, χ^2 is significant at 0.5 percent. So, in general if we run regression equation (4.1) for 1984, there are three economic ratios, X_5 (the ratio of interest payments on external public debt to

exports), X_6 (ratio of external public debt to GNP), and X_7 (ratio of debt services to GNP), which are significant considering all different combinations.

By running regression equation (4.1) for the years 1983 and 1984 and by looking at the results of different models (shown in Tables 4.1 and 4.2), we can conclude that the probability of rescheduling the debt by debtor country i can be explained by looking at economic ratios X_5 , X_6 , and X_7 . Economic ratios X_5 , X_6 , and X_7 are the three main variables that influence the probability of debt rescheduling by debtor country i . However, economic ratio X_7 (ratio of debt services to GNP), although it influences the probability of debt rescheduling by debtor country i , has the unexpected negative sign. Variables X_1 (the ratio of gross domestic investment to GNP), X_2 (the ratio of gross national savings to GNP), X_3 (the ratio of current account balance to GNP), and X_4 (the ratio of gross international reserves to imports) are not influential factors causing changes in the probability of debt rescheduling by the debtor country i .

Comparing the results with the study by William R. Cline (1984) (mentioned in Chapter II), I get the following: here X_4 (the ratio of gross international reserves to imports) is not significant but in Cline's study this ratio is significant and has the expected negative sign. X_2 (the ratio of gross national savings to GNP) is not significant in my study nor is it in Cline's study. X_2 and X_4 are the only common ratios between this study and Cline's study.

2) In this part I consider the following probit probability model for each country i :

$$P_t = b_0 + b_1W_{1t} + b_2W_{2t} + b_3W_{3t} + b_4W_{4t} + \dots + b_7W_{7t} + a_t \quad (4.2)$$

where t stands for the year under consideration and P is the probability of debt rescheduling by debtor country i and, of course, $0 \leq P \leq 1$.

Again, W_1, W_2, \dots, W_7 are economic ratios (indicators) of the debtor country i and they are defined as:

W_1 = Ratio of international reserves to imports of goods and services.

W_2 = Ratio of debt outstanding and disbursed to exports of goods and services.

W_3 = Ratio of debt outstanding and disbursed to GNP.

W_4 = Ratio of total debt services to exports of goods and services (debt-service ratio).

W_5 = Ratio of total debt services to GNP.

W_6 = Ratio of interest payments to exports of goods and services (interest-service ratio).

W_7 = Ratio of international reserves to debt outstanding and disbursed.

Equation (4.2) is estimated as a probit probability model for data for the year 1984. The six alternative models are shown in Table 4.3. These represent alternative combinations of the economic ratios (variables) when some economic ratios (variables) are counted out. The data are obtained from various issues of World Debt Tables published by the World Bank.

Table 4.3. Estimation of the probit model of debt reschedulings

Model	A	B	C	D	E	F
W ₁	-.16313 (.59221) ^b	-.31051 (-2.2769)	- ^a	-	-	-.30793 (-2.1896)
W ₂	-.0019341 (-.82641)	-	-	-.00012467 (.065212)	-.001999 (-1.0144)	-.00013302 (.072626)
W ₃	-.0002025 (-.01845)	-	-	-.012295 (1.5774)	-.0039446 (.45136)	-
W ₄	-.081997 (-1.6405)	-.072294 (-1.5824)	-.076709 (-1.6139)	-.036979 (-1.5356)	-	-.072114 (-1.5774)
W ₅	.022267 (.34956)	-	-	-	-	-
W ₆	.062937 (.90678)	.096877 (1.5423)	.069125 (1.1172)	-	-	.095860 (1.4908)
W ₇	-.096467 (-1.7807)	-	-.065425 (-2.6702)	-	-.071779 (-2.4028)	-
Observations	44	44	44	44	44	44
Reschedulings	18	18	18	18	18	18
Chi-squared	15.8505	9.91364	14.3166	5.19238	12.2052	9.9189
Degrees of freedom	7	3	3	3	3	4

^a- means not included.

^bT-statistics are in parentheses.

In model A, there are two variables, W_4 (the ratio of total debt services to exports of goods and services or debt-service ratio) and W_7 (the ratio of international reserves to debt outstanding and disbursed), which are significant. Variable W_4 is significant at the ten percent level but has an unexpected negative sign indicating that the higher the ratio of debt-service, the lower the probability of debt rescheduling by debtor country i . W_7 is significant at the five percent level and has the expected negative sign, which can be interpreted as, the higher the ratio of international reserves to debt outstanding and disbursed, the lower the probability of debt rescheduling by debtor country i . χ^2 (chi-squared) for model A is significant at the five percent level, indicating variation in the probability of debt reschedulings is very well explained by the considered variables W_1, W_2, \dots, W_7 in model A. The same story is true for model C in every aspect.

In model B, only variable W_1 (the ratio of international reserves to imports of goods and services) is significant at the five percent level and has the correct negative sign. This shows that the higher the ratio of international reserves to imports of goods and services, the lower the probability of debt rescheduling by debtor country i . χ^2 for model B is significant at the .5 percent level. Therefore, variables which are considered in model B strongly explain the variation in probability of debt rescheduling by country i . The same thing is exactly true considering model F in all details.

In model D, none of the variables are significant. In model E, only variable W_7 (the ratio of international reserves to debt outstanding and

disbursed) is significant at the five percent level and has the expected negative sign. This suggests that the higher the ratio of international reserves to debt outstanding and disbursed, the lower the probability of debt rescheduling by debtor country i .

3) As we saw in sections 1 and 2 of this chapter, there are two economic ratios--the debt-service ratio and ratio of debt services to GNP--which are significant (they have a significant effect on the probability of debt rescheduling) but have unexpected negative signs. We had the results that the higher the debt-service ratio (or ratio of debt services to GNP), the lower the probability of debt rescheduling by debtor country i .

In order to confirm these unexpected signs (whether these signs are statistically correct or not), I decided to combine all the data for the years 1980, 1981, 1982, 1983, and 1984 and run regression equation (4.2) again with the same seven economic ratios. The way that I have combined the data is as follows: First, I take the data for the 44 countries and for the year 1980, then I add the data for the same 44 countries and for the year 1981 to the data of the year 1980 vertically. I do the same thing for the data of the years 1982, 1983, and 1984, i.e., I add them up vertically to the combined data of 1980 and 1981. Therefore, if we consider the regression equation:

$$Y_{it} = b_0 + b_1 W_{1it} + b_2 W_{2it} + b_3 W_{3it} + \dots + b_7 W_{7it} + a_{it}$$

i the the number of observations and it goes from one to 220. The data

are collected from different issues of World Debt Tables published by the World Bank. The results are presented in Table 4.4. Again, I consider different combinations for the economic ratios in Table 4.4.

In model A, two variables, W_4 (the debt-service ratio) and W_7 (the ratio of international reserves to debt outstanding and disbursed), are highly significant. W_4 (the ratio of total debt services to exports of goods and services or debt-service ratio) is highly significant (it is significant at five percent), but again it has a negative sign meaning the higher the debt-service ratio, the lower the probability of debt rescheduling by debtor country i . Therefore, even if we pool the data we get the negative sign which is logically unexpected. W_7 (the ratio of international reserves to debt outstanding and disbursed) is highly significant (it is significant at one percent) and has the expected negative sign. It says the higher the ratio of international reserves to debt for debtor country i , the lower the probability of default by debtor country i . Of course, χ^2 (chi-squared) is significant at .5 percent, confirming that economic ratios considered in model A are very relevant to the probability of default.

In model C, again, variables W_4 and W_7 are significant at the five and one percent level, respectively, both with negative signs and the same interpretations as in model A. Of course, in model C, W_6 (the ratio of interest payments to exports of goods and services or interest-service ratio) is significant at one percent and carries the expected positive sign. This indicates that the higher the interest-service ratio for debtor country i , the higher the probability of default by country i . χ^2

Table 4.4. Estimation of the probit model of debt reschedulings

Model	A	B	C	D	E	F
W ₁	-.18576 (1.7903) ^b	-.13602 (-3.0288)	- ^a	-	-	-.103 (-2.2302)
W ₂	.0010410 (.81038)	-	-	.002211 (2.0146)	.0010471 (.96992)	.0030638 (3.0414)
W ₃	.0042271 (.64861)	-	-	.014364 (3.2021)	.0085072 (1.7735)	-
W ₄	-.056225 (-2.3814)	-.045941 (-2.2646)	-.053403 (-2.5167)	-.019456 (-1.8231)	-	-.048651 (-2.3599)
W ₅	.025532 (.62827)	-	-	-	-	-
W ₆	.043692 (1.2383)	.086807 (2.6197)	.074490 (2.2422)	-	-	.07236 (2.1677)
W ₇	-.036150 (-2.5361)	-	-.024437 (-4.0004)	-	-.015099 (-2.3029)	-
Observations	220	220	220	220	220	220
Reschedulings	54	54	54	54	54	54
Chi-squared	42.3171	16.9729	33.3746	27.9922	32.4813	27.0491
Degrees of freedom	7	3	3	3	3	4

^a- means not included.

^bT-statistics are in parentheses.

(chi-squared) for model C is significant at 0.5 percent. In model B, all of the variables are significant. Also, χ^2 for model B is significant at .5 percent suggesting that economic ratios (variables) considered in model B cause the variation in the probability of default by country i.

In model B, variables W_1 , W_4 , and W_6 are highly significant. They can be interpreted as: W_1 (the ratio of international reserves to imports of goods and services) is significant at one percent and has the anticipated negative sign. This means that the higher the ratio of international reserves to imports of goods and services, the lower the probability of debt rescheduling by debtor country i. W_4 (ratio of total debt services to exports of goods and services or debt-service ratio) is significant at five percent but again it has the unexpected negative sign meaning the higher the debt-service ratio, the lower the probability of debt rescheduling by debtor country i. Also, variable W_6 (ratio of interest payments to exports of goods and services or interest-service ratio) is significant at one percent with the correct positive sign. It shows the higher the interest-service ratio, the higher the probability of debt rescheduling by debtor country i.

In model D, variable W_2 (the ratio of debt outstanding and disbursed to exports of goods and services) is significant at five percent and has the expected positive sign. Therefore, the higher the ratio of debt to exports for country i, the higher the probability of default by country i. The same story is true with respect to variable W_3 (the ratio of debt outstanding and disbursed to GNP) in model D, i.e., W_3 in model D is significant at one percent and has the expected positive sign. So, W_3

contributes a lot to the probability of debt rescheduling by debtor country i . If the ratio of debt outstanding and disbursed to GNP is high for country i , we expect the probability of debt rescheduling by country i to be high. Again, in model D, W_4 (the debt-service ratio) is significant at five percent and has the unexpected negative sign. Of course, χ^2 (chi-squared) is significant at .5 percent for model D, showing the considered economic ratios (variables) in model D are relevant variables which explain the variation in the probability of debt rescheduling by country i .

In model E, variable W_7 (the ratio of international reserves to debt outstanding and disbursed) is significant at five percent and has the expected negative sign suggesting again that the higher the ratio of international reserves to debt for country i , the lower the probability of debt rescheduling by country i .

In model F, four variables, W_1 , W_2 , W_4 , and W_6 , are significant, which can be interpreted as: W_1 (the ratio of international reserves to imports of goods and services) is significant at five percent and has the expected negative sign, suggesting the higher the ratio of international reserves to imports of goods and services, the lower the probability of debt rescheduling for country i . W_2 (the ratio of debt outstanding and disbursed to exports of goods and services) is significant at one percent and has the correct positive sign. It means the higher the ratio of debt to exports for country i , the higher the probability of debt rescheduling for country i . W_4 (the debt-service ratio) is significant at five percent and again it has the unexpected negative sign. W_6 (the ratio of

interest payments to exports of goods and services or interest-service ratio) is significant at five percent and has the expected positive sign. This says, the higher the interest-service ratio for debtor country i , the larger the probability of debt rescheduling by debtor country i . χ^2 (chi-squared) for model F is significant at .5 percent suggesting that the considered economic ratios (variables) in model F are relevant variables which explain the variation in the probability of debt rescheduling by country i .

In general, by looking more closely at the results of sections 2 and 3 of this chapter we can summarize the following: among the seven economic ratios that we have considered in our study in sections 2 and 3, the following economic ratios are significant, i.e., they affect the probability of debt rescheduling by country i :

- a) W_1 (the ratio of international reserves to imports of goods and services) is significant and has the expected negative sign. It can be interpreted as: the higher the ratio of international reserves to imports of goods and services, the lower the probability of debt rescheduling by country i .
- b) W_7 (the ratio of international reserves to debt outstanding and disbursed) is significant and has the expected negative sign. This means the higher the ratio of international reserves to debt outstanding and disbursed by country i , the lower the probability of default by country i .
- c) W_6 (the ratio of interest payments to exports of goods and services or interest-service ratio) is significant and has the

expected positive sign. This says, the higher the interest-service ratio for debtor country i , the larger the probability of debt rescheduling by country i .

- d) W_2 (the ratio of debt outstanding and disbursed to exports of goods and services) is significant and carries the expected positive sign. This suggests, the higher the ratio of debt outstanding and disbursed to exports of goods and services for country i , the larger the probability of debt rescheduling by country i .
- e) W_3 (the ratio of debt outstanding and disbursed to GNP) is significant and has a positive sign which is expected. Therefore, the higher the ratio of debt outstanding and disbursed to GNP for country i , the higher the probability of debt rescheduling by country i .
- f) W_4 (the debt-service ratio) is significant but has the unexpected negative sign which suggests, the higher the debt-service ratio for country i , the lower the probability of debt rescheduling by country i .

4) As we observed in previous sections, there are key economic ratios: W_1 (ratio of international reserves to imports of goods and services), W_2 (ratio of debt outstanding and disbursed to exports of goods and services), W_3 (ratio of debt outstanding and disbursed to GNP), W_4 (ratio of total debt services to exports of goods and services or debt-service ratio), W_5 (ratio of total debt services to GNP), W_6 (ratio of interest payments to exports of goods and services or interest service

ratio), and W_7 (ratio of international reserves to debt outstanding and disbursed) which influences the probability of debt rescheduling by the debtor countries. These key economic ratios can serve as indicators that give information about the economic situation of the borrowing countries as well as the variation in the probability of debt rescheduling by them. When international financial institutions and western banks want to grant a loan to a borrowing country, they base their decision on the current economic information that they have about the borrowing country. But economic situation in the borrowing country can change. Therefore, if international financial institutions and western banks can get more accurate information about the future values of these key economic variables (ratios) of the borrowing country, they can use this information to adopt and conduct a better and safer loan policy. One way to forecast the future values of these key economic ratios, is to use the past data of these economic ratios. So I used the data (historic data of these key economic ratios mentioned above) for the years, 1970, 1974, 1975, 1976, 1978, 1979, 1980, 1981, 1982, 1983, and 1984 to get the forecasted value of the economic ratios: \hat{W}_1 (forecasted value of the ratio of international reserves to imports of goods and services), \hat{W}_2 (forecasted value of the ratio of debt outstanding and disbursed to exports of goods and services), \hat{W}_3 (forecasted value of the ratio of debt outstanding and disbursed to GNP), \hat{W}_4 (forecasted value of the ratio of total debt services to exports of goods and services or forecasted value of debt-service ratio), \hat{W}_5 (forecasted value of the ratio of total debt services to GNP), \hat{W}_6 (forecasted value of the ratio of interest payments

to exports of goods and services, and \hat{W}_7 (forecasted value of the ratio of international reserves to debt outstanding and disbursed).

Then, I consider the following probit regression equation:

$$P_t = \alpha_0 + \alpha_1 \hat{W}_{1t} + \alpha_2 \hat{W}_{2t} + \alpha_3 \hat{W}_{3t} + \alpha_4 \hat{W}_{4t} + \alpha_5 \hat{W}_{5t} \\ + \alpha_6 \hat{W}_{6t} + \alpha_7 \hat{W}_{7t} + a_t$$

where again t stands for the year under consideration, P is the probability of debt rescheduling, and $0 \leq P \leq 1$ and $\hat{X}_1, \hat{X}_2, \dots, \hat{X}_7$ are the forecasted economic ratios (variables) as:

\hat{W}_1 = Forecasted value of the ratio of international reserves to imports of goods and services for the year 1985.

\hat{W}_2 = Forecasted value of the ratio of debt outstanding and disbursed to exports of goods and services for the year 1985.

\hat{W}_3 = Forecasted value of the ratio of debt outstanding and disbursed to GNP for the year 1985.

\hat{W}_4 = Forecasted value of the ratio of total debt services to exports of goods and services (the forecasted value of debt-service ratio) for the year 1985.

\hat{W}_5 = Forecasted value of the ratio of total debt services to GNP for the year 1985.

\hat{W}_6 = Forecasted value of the ratio of interest payments to exports of goods and services for the year 1985.

\hat{W}_7 = Forecasted value of the ratio of international reserves to debt outstanding and disbursed for the year 1985.

I have run the above probit regression equation for forecasted ratios of 1985. Again the data are taken from various issues of World Debt Tables published by the World Bank. The results of this study are shown in Table 4.5.

In model A, there are two significant variables, \hat{W}_4 and \hat{W}_6 . \hat{W}_4 (the forecasted debt-service ratio) is significant at five percent and, again, here it has the unexpected negative sign. This means if we consider the forecasted debt-service ratio for debtor country i, we can expect the following: the higher the forecasted debt-service ratio, the lower the probability of debt rescheduling by country i, which is, of course, against our expectation. \hat{W}_6 (the forecasted ratio of interest payments to exports of goods and services) is significant at five percent and has the expected positive sign. This means the higher the forecasted ratio of interest payments to exports of goods and services, the more we should expect a debt rescheduling by country i. χ^2 (chi-squared) for model A is highly significant (it is significant at .5 percent) and confirms that the variation in the probability of debt rescheduling is very well explained by the variables $\hat{W}_1, \hat{W}_2, \dots, \hat{W}_7$ which are considered in model A.

In model B, only variable \hat{W}_6 is significant at five percent and has the correct positive sign. In model B, other variables are not significant. Again in model C, only variable \hat{W}_6 is significant at five

Table 4.5. Estimation of the probit model of debt reschedulings using forecasted economic ratios

Model	A	B	C	D	E	F
\hat{W}_1	-.014839 (.16030) ^b	-.061874 (-.85580)	- ^a	-	-	-.033176 (-.43334)
\hat{W}_2	.0021610 (.68362)	-	-	.00016696 (-.83149)	.00035721 (-.17482)	.0020305 (1.0646)
\hat{W}_3	.011741 (.61291)	-	-	.02433 (2.3123)	.026847 (2.4985)	-
\hat{W}_4	-.11681 (-1.7182)	-.038966 (-1.0011)	-.043563 (-1.0808)	-.0066898 (.33901)	-	-.039715 (-1.0070)
\hat{W}_5	.17868 (1.0804)	-	-	-	-	-
\hat{W}_6	.17347 (1.9270)	.12627 (1.8395)	.12758 (1.8295)	-	-	.11589 (1.6610)
\hat{W}_7	-.00040132 (-.047126)	-	-.0051662 (-.76971)	-	-.004435 (.61208)	-
Observations	44	44	44	44	44	44
Reschedulings	20	20	20	20	20	20
Chi-squared	16.0598	5.6752	5.52925	10.4088	10.6749	6.92115
Degrees of freedom	7	3	3	3	3	4

^a- means not included.

^bT-statistics are in parentheses.

percent with the expected positive sign. χ^2 (chi-squared) for both models B and C is significant at ten percent.

In model D, only variable \hat{W}_3 (the forecasted ratio of debt outstanding and disbursed to GNP) is significant at five percent and has the expected positive sign. Therefore, the bigger the forecasted ratio of debt outstanding and disbursed to GNP, the higher the probability of debt rescheduling by country i. χ^2 (chi-squared) for model D is significant at two percent, i.e., the probability of debt rescheduling by country i is strongly affected by the variables \hat{W}_2 , \hat{W}_3 , and \hat{W}_4 .

In model E, only variable \hat{W}_3 is significant and has the expected positive sign. Of course, χ^2 (chi-squared) is significant at two percent for model E. In model F, none of the variables are significant.

In general (for this part of the study), we can summarize the following: there are three forecasted economic ratios which are significant and they affect the probability of debt rescheduling by country i very strongly. These three forecasted economic ratios are \hat{W}_3 , \hat{W}_4 , and \hat{W}_6 . \hat{W}_3 (the forecasted ratio of debt outstanding and disbursed to GNP) and \hat{W}_6 (the forecasted ratio of interest payments to exports of goods and services) have the expected positive signs. \hat{W}_4 (the forecasted debt-service ratio) is significant but has the unexpected negative sign.

CHAPTER V. SUMMARY AND CONCLUSION

In this study, I have tried to add some statistical analytics to a subject that is being frequently discussed from a rather economic view point. The point is (as I mentioned in Chapter I) whether in fact there is a relationship between the financial-ratio profile of the less-developed debtor countries and their reschedulings of the external liabilities. I have examined these relationships (as much as the available data allowed me) using probit probability technique. Applying this technique, I take economic ratios (like the ratio of debt to GNP, etc.) as independent variables and, of course, the dependent variable is the rescheduling positions of the debtor countries. After looking at the results and examining them I can conclude that economic ratios like the ratio of international reserves to imports of goods and services, the ratio of interest payments to exports of goods and services or interest-service ratio, the ratio of debt outstanding and disbursed to exports of goods and services, and the ratio of debt outstanding and disbursed to GNP are statistically significant and their coefficients have the expected positive signs. This can be interpreted that any increase in those ratios is going to increase the probability of rescheduling of the debts by debtor countries. Therefore, by looking at these financial ratios of a particular debtor country we can obtain some information about the creditworthiness of the country. However, economic ratios such as: ratio of debt services to GNP, and the ratio of total debt services to exports of goods and services or debt-service ratio are

statistically significant but their coefficients have negative signs. This means, the higher these ratios are, the lower the probability of rescheduling by the debtor country is going to be. Of course, this is against the expectation. Considering this fact, it is difficult to come up with any strong inference about the relationship between the creditworthiness of a debtor country and its economic-ratio profile. Even though study of this kind can be enlightening, any statement or inference about the creditworthiness of a debtor country should be supplemented with the information obtained from the economic ratios and other socio-political and economic pertaining to the debtor country.

BIBLIOGRAPHY

- Balassa, Beld. "The Newly-Industrialized Developing Countries After the Oil Crisis." *Weltwirtschaftliches Archive* 117 (1981):142-194.
- Claudon, Michael P., ed. World Debt Crisis: International Lending on Trial. Cambridge, Massachusetts: Ballinger Publishing Company, 1986.
- Cline, William R. International Debt: Systematic Risk and Policy Response. Cambridge, Massachusetts: MIT Press, 1984.
- Darity, William Jr. "Did the Commercial Banks Put Loans on the LDCs?" In Michael P. Claudon, ed., World Debt Crisis: International Lending on Trial. Cambridge, Massachusetts: Ballinger Publishing Company, 1986.
- de Vries, Barend A. "Future Capital Flows: Critical Improvements and the Role of Coordination." In Michael P. Claudon, ed., World Debt Crisis: International Lending on Trial. Cambridge, Massachusetts: Ballinger Publishing Company, 1986.
- Friedman, Irving S. The World Debt Dilemma: Managing Country Risk. Philadelphia, Pennsylvania: Robert Morris Associates, 1983.
- Halberg, Kristin. "International Debt, 1985: Origins and Issues for the Future." In Michael P. Claudon, ed., World Debt Crisis: International Lending on Trial. Cambridge, Massachusetts: Ballinger Publishing Company, 1986.
- IMF. International Financial Statistics Yearbook. Washington, D.C.: IMF, 1982.

- Ladd, George W. "Linear Probability Functions and Discriminate Functions." Econometrica 34 (October 1966):873-885.
- Mattione, Richard P. "Managing World Debt: Past Lessons and Future Prospects." In Michael P. Claudon, ed., World Debt Crisis: International Lending on Trial. Cambridge, Massachusetts: Ballinger Publishing Company, 1986.
- Niehans, Jürg. "International Debt with Unenforceable Claims." Federal Reserve Bank of San Francisco 1 (Winter 1985):64-78.
- Pindyck, Robert S., and Daniel L. Rubinfeld. Econometric Models and Economic Forecasts. New York: McGraw-Hill Book Company, 1981.
- Santam, Leonard J. "The View from Wall Street." In Michael P. Claudon, ed., World Debt Crisis: International Lending on Trial. Cambridge, Massachusetts: Ballinger Publishing Company, 1986.
- Walter, Ingo. "International Capital Allocation: Country Risk, Portfolio Decisions and Regulation in International Banking." Mimeo. Presented at Conference on Internationalization of Financial Markets and National Economic Policy, New York, April 1980.
- World Bank. World Development Report 1985. New York: Oxford University Press, 1985.
- World Bank. World Debt Tables. New York: Oxford University Press, various issues.
- World Bank. World Development Report. New York: Oxford University Press, various issues.

ACKNOWLEDGMENTS

I want to thank Cervantes (Don Quixote); without his way of looking at the world I would not have been able to finish my work. He was and always is the source of endless inspiration for me.

More than anyone else, I thank Dr. Dudley G. Luckett for his supervision, comments, and kindness. He was always helpful and supportive. I owe him a great deal. Millions of thanks to Dr. Dennis Starleaf who agreed to be my major professor. He put a great deal of his valuable time into reading my dissertation, correcting it, and giving me helpful comments. The truth is that without his support it would have been difficult for me to finish my dissertation. Also, I am deeply grateful to Dr. Roy Adams and Dr. James Prescott as members of my committee. They gave me nice comments and excellent suggestions about my work. They are greatly appreciated.

Special thanks goes to Dr. Roy Hickman and Dr. Robert Thomas who kindly agreed to help me.

I also thank my good friend Ms. Diana McLaughlin for her patience and her dedication for the laborious task of flawless typing and putting the dissertation together.